



THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 10/697,570 Confirmation No: 8422  
Applicant : Nicholas G. GREY, *et al.*  
Filed : October 31, 2003  
Group Art Unit : 17426  
Examiner : Frankie L. Stinson  
Title : SURFACE CLEANING APPARATUS  
Docket No. : 100103.52885US  
Customer No. : 30902

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**SUBMISSION OF CERTIFIED COPY OF  
FOREIGN PRIORITY DOCUMENT**

Dear Sir:

The filing papers claimed priority under 35 U.S.C. § 119 on the basis of UK Patent Application No. 0225618.8, which was filed on November 2, 2002. Pursuant to 35 U.S.C. § 119, a certified copy of said UK patent application is submitted herewith, thereby perfecting the priority claim.

The Commissioner is hereby authorized to charge any additional fees under 37 C.F.R. §§ 1.16 and 1.17 that may be required by this submission, or to credit any overpayment, to Deposit Account No. 19-2112 referencing Attorney Docket No. ERPC.117628.

Respectfully submitted,

Date: January 26, 2005  
By:   
Lawrence E. Carter  
Reg. No. 51,532

SHOOK, HARDY & BACON L.L.P.  
600 14<sup>th</sup> Street, N.W., Suite 800  
Washington, D.C. 20005-2004  
Phone: (202) 783-8400  
Fax: (202) 783-4211

**THIS PAGE BLANK (USPTO)**



INVESTOR IN PEOPLE

The Patent Office  
Concept House  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ

## Best Available Copy

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in the certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in the certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, Ltd. C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

### CERTIFIED COPY OF PRIORITY DOCUMENT

Signed

Dated

*R. Mahoney*  
26 September 2003

THIS PAGE BLANK (USPTO)

04NOV02 E769704-1 002746  
P01/7700 0.00-0225618.8**Request for grant of a patent**

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

THE PATENT OFFICE  
H  
- 2 NOV 2002  
NEWPORT

The Patent Office

 Cardiff Road  
Newport  
South Wales  
NP10 8QQ

## 1. Your reference

P0793

02 NOV 2002

## 2. Patent application number

(The Patent Office will fill in this part)

0225618.8

3. Full name, address and postcode of the or of each applicant (*underline all surnames*)
 Nicholas Gerald GREY  
 7 Laxton Close  
 Crowle  
 Worcestershire WR7 4BH
Patents ADP number (*if you know it*)

If the applicant is a corporate body, give the country/state of its incorporation

8192577002

## 4. Title of the invention

Surface cleaning apparatus including a surface cleaning strip and/or rotatable brush arrangement and/or means of cleaning an area beyond a brush bar cylinder of the surface cleaning apparatus.

5. Name of your agent (*if you have one*)
 "Address for service" in the United Kingdom to which all correspondence should be sent  
*(including the postcode)*

DEREK JACKSON ASSOCIATES

 The Old Yard, Lower Town  
 Claines  
 Worcester WR3 7RY
Patents ADP number (*if you know it*)

560046202

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (*if you know it*) the or each application number
 Country      Priority application number  
*(if you know it)*      Date of filing  
*(day / month / year)*

## 7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

 Number of earlier application      Date of filing  
*(day / month / year)*

## 8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

- a) *any applicant named in part 3 is not an inventor, or*
- b) *there is an inventor who is not named as an applicant, or*
- c) *any named applicant is a corporate body.*

*See note (d))*

No

# Patents Form 1/77

Enter the number of sheets for any of the following items you are filing with this form.  
Do not count copies of the same document

Continuation sheets of this form

Description 41

Claim(s)

Abstract

Drawing(s)

16 + 16

JMC

10. If you are also filing any of the following,  
state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right  
to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination  
and search (*Patents Form 9/77*)

Request for substantive examination  
(*Patents Form 10/77*)

Any other documents  
(please specify)

11.

I/We request the grant of a patent on the basis of this application.

Signature

*Derek Jackson Associates*

Date

1 Nov 2002

12. Name and daytime telephone number of  
person to contact in the United Kingdom

Derek Jackson - Tel : 01905 755180

## Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

## Notes

- a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.
- b) Write your answers in capital letters using black ink or you may type them.
- c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- e) Once you have filled in the form you must remember to sign and date it.
- f) For details of the fee and ways to pay please contact the Patent Office.

SURFACE CLEANING APPARATUS INCLUDING A SURFACE CLEANING STRIP AND/OR ROTATABLE BRUSH ARRANGEMENT AND/OR MEANS OF CLEANING AN AREA BEYOND A BRUSH BAR CYLINDER OF THE SURFACE CLEANING APPARATUS

5

This invention relates to a surface cleaning apparatus including a surface cleaning strip and/or a rotatable brush arrangement and/or means of cleaning an area beyond a brush bar cylinder of the surface cleaning apparatus, such as for  
10 cleaning hard floor surfaces.

Current vacuum cleaner attachments generally employ a flexible cleaning strip intended for cleaning hard floor  
15 surfaces, for example tiles, marble or linoleum. The flexible strip is intended to increase air speed and mechanically gather particles to assist performance. On a forward stroke the flexible strip will drag particles forward. When the vacuum cleaner attachment is pulled in a rearward direction, the gathered particles are extracted by  
20 the suction. The flexible strip can gather particles on the rearward side, away from the suction when the attachment is pulled in a rearward direction. However, the action of the suction itself causes the majority of the particles on the  
25 rearward side of the flexible strip to pass under the flexible strip and be removed.

For surface cleaning apparatus which do not use suction, for example, sweeper type floor cleaning apparatus using  
30 rotatable brushes to pick up and collect particles, the presence of a flexible cleaning strip for cleaning hard floor surfaces results in particles becoming trapped behind the flexible strip when the sweeper is pulled in a rearwards direction, resulting in particles being held away  
35 from the brushes.

It is also known that the edge of a flexible cleaning strip used to clean hard floor surfaces can wear out relatively quickly due to the constant contact with the hard floor .

surface when in use. Flexible strips used on devices, for example, for washing hard floor surface are known to wear out relatively quickly without the benefit of a lubricating cleaning solution which reduces friction between the 5 flexible strip and the floor.

In sweeper type floor cleaning apparatus the current rotatable brush arrangement comprises rows of bristles, with all of the bristles having substantially the same 10 thickness and diameter. The bristles used are relatively thick and short, and must be of sufficient stiffness to support the floor cleaning apparatus relative to the surface to be swept. However, if a floor surface is irregular, for example there are cracks or crevices, the 15 bristles on the current brush arrangement cannot reach down into the irregularities and extract particles.

In sweeper type floor cleaning apparatus the bristles on the current rotatable brush arrangement are generally 20 arranged radially from a horizontal cylindrical body supported within the body of the cleaning apparatus. Sweeping of a surface to be cleaned occurs in an area directly below the cylindrical body of the brush and not to the full width of the floor cleaning apparatus. As such the 25 rotatable brush arrangement is unable to sweep fully to an edge of a surface where it joins an upright feature, for example a wall or skirting board of a wall.

Additional rotary brushes provided adjacent to the side of 30 the body of the cleaning apparatus can be provided. The additional rotary brushes are arranged to rotate about a vertical axis such that the an area alongside the surface cleaning apparatus can be swept. However the construction of a cleaning apparatus with such an additional rotary

brush is relatively complicated and as such relatively expensive.

It is therefore an object of the present invention to  
5 provide a surface cleaning apparatus including a surface  
cleaning strip and/or a rotatable brush arrangement and/or  
means of cleaning an area beyond a brush bar cylinder of  
the surface cleaning apparatus which overcomes, or at least  
ameliorates, the problems of known apparatus.

10

According to one aspect of the present invention there is provided a surface cleaning apparatus including a surface cleaning strip and means for positioning the cleaning strip relative to a surface to be cleaned, the apparatus including means adapted to determine a direction of movement of the surface cleaning apparatus over the surface to be cleaned and control means operably connected with the movement determining means for controlling the position of the cleaning strip depending on the direction of movement  
15 of the surface cleaning apparatus.  
20

The movement determining means may comprise at least one motion detector, such as an electronic motion detector.

25 Alternatively, the movement determining means may comprise means adapted to frictionally engage the surface to be cleaned.

Movement of the surface cleaning apparatus in a first  
30 direction relative to the floor may cause the friction means to be moved in a first direction relative to a body of the surface cleaning apparatus and cause the cleaning strip to be in a first orientation or elevation to the body

of the surface cleaning apparatus whereby the strip member is in contact with the floor.

Movement of the surface cleaning apparatus in a second direction relative to the floor, wherein the second direction is in an opposite direction to the first, may cause the at least one friction means in contact with the floor to be moved in a second direction, opposite to the first direction of the at least one friction means, relative to the body of the surface cleaning apparatus and cause the cleaning strip to be in a second orientation or elevation to the body of the surface cleaning apparatus whereby the strip member is raised clear of the floor.

The first direction of movement of the surface cleaning apparatus may be in a forward direction.

The first direction of movement of the friction means may be in a rearward direction.

The cleaning strip may be raised and lowered relative to the floor by means of being urged in a substantially upward and downward direction respectively by the end of a first arm, rotated about an axis of a first pivotable member, for example a pivot pin, the first arm being connected via the first pivotable member to the at least one friction means and being rotated relative to the axis of the first pivotable member by the movement of the at least one friction means in contact with the floor.

The cleaning strip may be attached to a second arm wherein an end of the second arm furthest from the cleaning strip is attached to a second pivotable member, for example a

pivot pin. The cleaning strip may be moved relative to the floor by means of the second arm rotating about the axis of a second pivotable member.

5      The cleaning strip may be raised and lowered relative to the floor by means of being rotated about a elongate member with a substantially circular cross-sectional area whereby movement of the portion of the friction means in contact with the floor causes rotation of the elongate member in a first direction, relative to the body of the surface cleaning apparatus, and results in the first orientation wherein the strip member is in contact with the surface of a floor. Rotation of the elongate member in a second direction, relative to the body of the surface cleaning apparatus, results in the second orientation of the elongate member wherein the strip member is raised away from the floor surface.

10

15      The cleaning strip may comprise an elongate member and a strip member attached along a first end to the elongate member and free along a second end, the strip member extending substantially the entire width of the elongate member.

20      The elongate member may have a substantially circular cross-section.

The elongate member may comprise a flexible material, for example a plastics or rubber material.

25      The strip member may comprise a flexible material, for example a plastics or rubber material.

The cleaning strip may also comprise at least one friction means attached at a first end to the elongate member and free at a second end.

- 5      The at least one friction means may comprise a flexible material, for example a plastics or rubber material.

The strip member may be positioned at an angle relative to the at least one friction means

- 10     The at least one friction means and the strip member may be positioned relative to one another at an angle of substantially 45 degrees.

- 15     The at least one friction means may comprise a tab.

The at least one tab and the strip member may be formed integrally with the elongate member.

- 20     The first end of the at least one tab and the first end of the strip member may be in contact with each other.

The at least one tab and the strip member may extend in a generally radial direction from the elongate member.

- 25     According to a second aspect of the present invention there is provided a rotatable brush arrangement for a surface cleaning apparatus, the brush arrangement comprising an elongate cylindrical member and bristles attached to the cylindrical member, wherein the bristles comprise at least two different types.

The bristles may extend radially from the cylindrical member.

The bristles may be attached along the length of the cylindrical member.

5 The at least two types of bristles may be arranged helically around the elongate cylindrical member.

The at least two types of bristles may be arranged in at least one row, preferably at least two rows.

10 The at least two rows of bristles may be arranged such that each row only contains bristles of a single type.

15 The at least two different types of bristles may comprise bristles of different lengths and/or thickness. The length of the bristles may be in a range from 8 mm to 25mm, preferably a range from 14 mm to 17 mm. The thickness of individual bristles may be in a range from 0.04 mm to 0.3 mm, preferably in a range from 0.06 mm to 0.25mm. The bristles may be arranged in tufts and the tufts may have a 20 diameter in a range from 1.5 mm to 5 mm, preferably a range from 2 mm to 3 mm. Thus the bristles may be of different dimensions to facilitate cleaning an uneven surface.

25 According to a third aspect of the present invention there is provided a surface cleaning apparatus comprising a housing and a rotatable brush arrangement positioned within the housing, wherein the rotatable brush arrangement comprises the cylindrical member having a plurality of tufts of bristles attached therewith, at least one tuft of 30 bristles in an end region of the cylindrical member extending towards an end of the cylindrical member, and wherein the housing is provided with an opening to allow the at least one tuft of bristles to extend laterally outwards beyond an end of the cylindrical member during a 35 part of each rotation of the cylindrical member and with

deflecting means for directing the at least one tuft of bristles back towards the cylindrical member.

5 The plurality of tufts of bristles may be arranged in at least one row.

The at least one tuft of bristles may extend laterally beyond the housing.

10 Thus, as the brush arrangement rotates within the housing of the surface cleaning apparatus the at least one tuft of bristles, on reaching the opening, is able to move axially outward of the housing to clean an area beyond the end of the cylindrical member, and preferably alongside the  
15 housing, before encountering the deflecting means and being directed back towards the cylindrical member within the housing until the cylindrical member has rotated sufficiently for the at least one tuft of bristles to reach the opening once again.

20 The deflecting means may be an edge, preferably a rearward edge, of the opening.

25 The rearward edge of the opening may be contoured to assist in deflecting the at least one tuft of bristles back into the housing.

A first embodiment of a surface cleaning apparatus incorporating the cleaning strip and/or the rotatable brush arrangement and/or means of cleaning an area beyond the brush bar cylinder of the surface cleaning apparatus may comprise a body comprising a rear compartment, a forward compartment and an intermediate compartment arranged between the rear and forward compartments; the elongate  
30 rotatable brush arrangement positioned within and extending  
35

across the forward compartment; an electric motor positioned in the rear compartment; and drive means extending between the rotatable brush arrangement and the electric motor.

5

A battery, such as a rechargeable battery, may be positioned in the rear compartment together with the electric motor. Alternatively, the electric motor may be mains powered.

10

The rotatable brush arrangement may extend substantially the entire width of the forward compartment.

15

The intermediate compartment may be provided with a removable closure, such as a removable side wall, for the removal of debris therefrom.

20

The drive means may pass at least partly through the intermediate compartment. The drive means may pass through a tunnel which passes at least partly through the intermediate compartment. The drive means may be positioned adjacent one side of the intermediate compartment.

25

The drive means may comprise a belt, for example a toothed belt, drive.

30

A wall may be provided between the rear compartment and the intermediate compartment to seal the rear compartment from the intermediate compartment.

35

A wall may be provided between the intermediate compartment and the forward compartment, the wall extending from the base of the intermediate compartment and terminating short of the top thereof. The top of the wall may be at

substantially the same height as the top of the brush arrangement. The wall may be inclined rearwardly. The angle of inclination may be in the range of 15 to 20 degrees, for example.

5

The wall between the intermediate compartment and the forward compartment may include a cavity in a lower edge of the wall into which the elongate member of the cleaning strip is supported by retaining means. The cleaning strip may protrude through an open face of the cavity such that the strip member and the at least one tab is directed towards a surface to be cleaned. The cavity may have a substantially upright first main wall, and a second main wall, opposite to the first wall and angled, for example, at 60 degrees away from the first wall. A surface of the cavity furthest from the open face may have a surface curvature complementary to the curved surface of the elongate member.

10

20 The retaining means may comprise a plurality of clips extending from the first wall of the cavity and overlying portions of the elongate member such that the elongate member is held within the cavity.

15

25 The surface cleaning apparatus may incorporate handle means. The length of the handle means may be varied. For example, the handle means may be interchangeable. Thus, one handle means may be relatively short and another handle means may be relatively long. Alternatively, the other handle means may serve to extend the one handle means. The handle means, or at least the relatively long handle means, may be rotatable about the axis thereof to facilitate steering of the apparatus and/or may be pivotable about an axis transverse to the axial direction thereof.

An auxiliary brush arrangement may be provided at one side of the body of the surface cleaning apparatus. The auxiliary brush arrangement may extend outwardly from the forward compartment. The auxiliary brush arrangement may 5 rotate about an axis inclined to the vertical. The auxiliary brush arrangement may be provided with radial bristles. The radial bristles may be inclined at an acute angle to the axis of rotation of the auxiliary brush arrangement. The auxiliary brush arrangement may be driven 10 by the electric motor or by friction.

The forward compartment includes in the lower face thereof an aperture through which bristles of the brush arrangement protrude. A front part of the forward compartment may be 15 movable to expose bristles at the front of the apparatus. For example, the cover may be removable or may be pivotable, or otherwise movable, to expose bristles at the front of the apparatus.

20 The rear compartment may be provided with ground-engaging wheels.

A second embodiment of a surface cleaning apparatus incorporating the cleaning strip and/or the rotatable brush arrangement and/or means of cleaning an area beyond the brush bar cylinder of the surface cleaning apparatus in accordance with the present invention may comprise a body 25 provided with an electric motor and drive means extending between the rotatable brush arrangement and the electric motor, wherein the body is provided remote from the brush arrangement with one or more ground-engaging wheels.

The second embodiment utilizing the invention may incorporate features from the first embodiment.

A third embodiment of a surface cleaning apparatus incorporating the cleaning strip and/or the rotatable brush arrangement and/or means of cleaning an area beyond the brush bar cylinder of the surface cleaning apparatus according to the present invention may comprise a housing provided with a movable (including removable) cover for part of the brush arrangement.

Thus, the apparatus can clean surfaces that would not be possible with an apparatus having a front cover extending down to the level of the base of the apparatus and can, for example, clean the front faces of steps.

The third embodiment utilizing the invention may incorporate features from the first embodiment.

A fourth embodiment of a surface cleaning apparatus incorporating the cleaning strip and/or the rotatable brush arrangement and/or means of cleaning an area beyond the brush bar cylinder of the surface cleaning apparatus according to the present invention may comprise a housing provided with the elongate rotatable brush arrangement, wherein bristles of the brush arrangement extend beneath the body to such an extent that the body can be inclined in use to increase contact between the bristles and a surface to be cleaned.

Thus, the housing may be inclined to increase contact between the bristles of the brush arrangement and the surface being cleaned or to increase the depth to which the bristles of the brush arrangement may penetrate the surface being cleaned.

The fourth embodiment utilizing the invention may incorporate features from the first embodiment.

A fifth embodiment of a surface cleaning apparatus incorporating the cleaning strip and/or the rotatable brush arrangement and/or means of cleaning an area beyond the brush bar cylinder of the surface cleaning apparatus in accordance with the present invention may comprise a body provided with an electric motor and drive means extending between the rotatable brush arrangement and the electric motor, wherein the body is provided with handle means, the length of which handle means may be varied.

10

The fifth embodiment utilizing the invention may incorporate features from the first embodiment.

15

A sixth embodiment of a surface cleaning apparatus incorporating the cleaning strip and/or the rotatable brush arrangement and/or means of cleaning an area beyond the brush bar cylinder of the surface cleaning apparatus in accordance with the present invention may comprise a body provided with an electric motor and drive means extending between the rotatable brush arrangement and the electric motor, wherein the body is provided with handle means mounted to be pivotable about a longitudinal axis thereof such that pivoting of the handle facilitates steering of the apparatus.

25

The sixth embodiment utilizing the invention may incorporate features from the first embodiment.

30

A seventh embodiment of a surface cleaning apparatus incorporating the cleaning strip and/or the rotatable brush arrangement and/or means of cleaning an area beyond the brush bar cylinder of the surface cleaning apparatus in accordance with the present invention may comprise: a housing adapted to be propelled at least in a forwards direction on the surface; the elongate brush arrangement

35

supported for rotation in and extending transversely of the housing and adapted to contact the surface; means to rotate the elongate brush arrangement; and at least one auxiliary brush means of substantially circular form extending outwardly from the housing and adapted to be rotatably driven by means within the housing, such that during rotation of the at least one auxiliary brush means, a peripheral region thereof angularly rotates to sweep debris into the path of the elongate brush arrangement.

10

The at least one auxiliary brush means may be arranged for rotation about a vertical axis or about an axis inclined to vertical.

15

The at least one auxiliary brush means may be arranged to extend outwardly from a right and/or left hand side of the housing. When such an auxiliary brush means extends outwardly from a right hand side of the housing, as viewed from above and behind the housing, the auxiliary brush means is arranged to be rotated in an anti-clockwise direction, as so viewed. When such an auxiliary brush means extends outwardly from a left hand side of the housing, as viewed from above and behind the housing, the auxiliary brush means is arranged to be rotated in a clockwise direction, as so viewed.

25

The at least one auxiliary brush means may be provided with radial bristles which may be inclined at an acute angle to an axis of rotation of the at least one auxiliary brush means.

30

The at least one auxiliary brush means may be rotatably driven by the elongate brush arrangement and suitably by gear means provided at at least one end of the elongate brush arrangement.

35

The at least one auxiliary brush means and/or the elongate brush arrangement may be adapted for rotation by means of at least one electric motor provided in the housing. Such at least one electric motor may be battery or mains operated.

Alternatively, the elongate brush arrangement may be adapted to be rotated by friction means resulting from propelling the housing across the surface, the elongate brush arrangement so rotated being adapted to rotate the at least one auxiliary brush means.

The housing may be provided with one or more wheels for engaging the surface and for enabling or assisting propulsion of the housing along the surface.

The housing may be provided with a compartment for receiving debris picked up from the surface by the elongate brush arrangement.

Alternatively, the housing may be provided with outlet means, such as a pipe or hose means, for directing debris, picked up from the surface by the elongate brush arrangement, into a receiving container, such as a bag, located elsewhere in or on the apparatus.

The housing may be adapted for demountable or fixed connection to suction hose means, such suction hose means being adapted to receive from the housing debris picked up from the surface by the elongate brush arrangement. The suction hose means may incorporate electrical wiring and connection means, by means of which one or more electric motors in the housing may be powered from a remote source, such as electric mains, or battery means.

The surface for cleaning by the apparatus of the present invention may be any surface which is to be swept and may be a floor, stairway, or upholstery, of premises or vehicles.

5

For a better understanding of the present invention and to show more clearly how it may be carried into effect reference will now be made, by way of example, to the accompanying drawings in which:

10

Figure 1 is a plan view of one embodiment of a surface cleaning apparatus incorporating a cleaning strip according to the present invention;

15

Figure 2 is a side elevational view, partly in section, of the surface cleaning apparatus shown in Figure 1;

Figure 3 is a perspective view of a brush arrangement of the surface cleaning apparatus of Figures 1 and 2;

20

Figure 4 is a perspective view of a cleaning strip in accordance with the present invention;

25

Figure 5 is a perspective view of another embodiment of the cleaning strip in accordance with the present invention;

Figure 6 is an elevational view of the surface cleaning apparatus of Figures 1 and 2 with an alternative handle;

30

Figure 7 is an expanded view of one end of the brush arrangement in Figure 3 in relation to a surface to be cleaned;

35

Figure 8 is a perspective view of the cleaning strip in a first and second orientation;

Figure 9 is a perspective view of another embodiment of surface cleaning apparatus according to the present invention with part of a brush bar cover removed for clarity;

5

Figure 10 is a perspective view of the apparatus of Figure 9, with part of the housing thereof removed;

10 Figure 11 is an underside view of the apparatus of Figure 9 with part of the brush bar cover removed for clarity;

15 Figure 12 is a perspective view of an alternative embodiment of surface cleaning apparatus incorporating a cleaning strip according to the present invention with part of the brush bar cover removed for clarity (shown in dashed lines);

20 Figure 13 is a perspective view of a further embodiment of surface cleaning apparatus incorporating a cleaning strip according to the present invention with part of the brush bar cover removed for clarity (shown in dashed lines);

25 Figure 14 is a perspective view of an alternative embodiment of the cleaning strip in a lowered and raised position, showing the relationship between the cleaning strip and a separate friction means;

Figure 15 is a further embodiment of the cleaning strip in the lowered position;

30

Figure 16 is the perspective view of the alternative embodiment of the cleaning strip in Figure 14, showing an alternative embodiment of the friction means;

Figure 17 is a further embodiment of the rotatable brush arrangement; and

5       Figure 18 is an elevational view of a modification of the surface cleaning apparatus of Figures 1 and 2 with a deflecting means present in the brush arrangement housing.

10      The surface cleaning apparatus incorporating the cleaning strip shown in Figures 1 to 4 comprises a body 1, suitably moulded of plastics material, and having effectively three compartments.

15      A rear compartment 3 houses an electric motor 5 and a rechargeable battery pack 7. The battery pack 7 may be connected to a mains power supply (not shown) for recharging the battery pack. The battery pack may either be connected to the mains supply whenever the apparatus is not in use or at suitable times when the battery pack has become depleted. Switch means (not shown) is provided to permit a user to energise and de-energise the motor 5 as desired. As an alternative to a rechargeable battery pack, the apparatus could employ disposable batteries or be mains powered.

25      A forward compartment 9 houses an elongate rotatable brush arrangement 11. For convenience a forward wall of the forward compartment is arcuate and extends around the periphery of the brush arrangement 11. The bottom of the forward compartment is open at 13 to allow the bristles of the brush arrangement to contact a floor, carpet or the like over which the surface cleaning apparatus is to be moved.

35      The rear of the forward compartment is a rearwardly inclined wall 15 which allows debris, such as dust, dirt

and the like, to be propelled up the wall due to rotation of the brush arrangement 11 and to pass over the wall into an intermediate compartment 17 which will be described in more detail hereinafter. The wall 15 extends upwardly to  
5 about the same height as the top of the brush arrangement 11 and is angled rearwardly (i.e. away from the forward compartment) at an angle of about 18 degrees. The precise angle is not important, but the inclination facilitates the passage of the debris up and over the wall and at the same  
10 time facilitates retention of the debris within the intermediate compartment 17.

The brush arrangement extends substantially the entire width of the forward compartment and is provided with two  
15 helically arranged rows of bristles. The two rows are diametrically opposed and each row is in the form of a pair of separate helices which twist in opposite directions and meet substantially midway between the ends of the brush arrangement. The brush arrangement comprises bristles 118.  
20 The length of the bristles, for example, are in a range from 8 mm to 25 mm, preferably a range from 14 mm to 17 mm. The thickness of individual bristles are in a range from 0.04 mm to 0.3 mm, preferably in a range from 0.06 mm to 0.25mm. The bristles are arranged in tufts and the tufts  
25 have a diameter in a range from 1.5 mm to 5 mm, preferably a range from 2 mm to 3 mm.

As shown in Figure 3, the bristles comprise two different types in the form of standard bristles 119 and fine  
30 bristles 121. The bristles are arranged such that the standard bristles comprise one of the helical rows, whilst the fine bristles comprise the other helical row. It should be appreciated, however, that the bristles could be arranged such that a mixture of bristle types are present together in a single helical row. Mounted in and along the  
35

lower edge of the wall 15, behind the elongate brush arrangement, is a cleaning strip, for example for cleaning hard floor surfaces, as shown in Figure 4, which will be described in more detail hereinafter.

5

The intermediate compartment 17, shown in Figures 1 and 2, is positioned between the wall 15 and a wall 21 which encloses the electrical components 5, 7 in the rear compartment 3, the wall 21 protecting the components in the rear compartment from the ingress of debris. The intermediate compartment 17 also has a lower wall, an upper wall and side walls formed by the outer wall of the body 1. Debris therefore accumulates within the intermediate compartment 17. The intermediate compartment is provided with a removable closure to facilitate the removal of debris. For example, one of the walls, such as a side wall, the upper wall or the lower wall, can be removed in order that the debris can be emptied from the intermediate compartment, the removed wall being replaced once the compartment has been emptied. Ideally, side wall 23 is removable for emptying purposes. The wall 15 provides the advantage that debris does not readily escape from the intermediate compartment 17 and, even if the body is inclined such that the forward compartment is below the intermediate compartment, the debris does not escape from the intermediate compartment.

30

35

30

The brush arrangement 11 is rotated by the motor 5 by way of toothed rollers 25, 27 attached to the motor and to the brush, respectively, and by way of a toothed belt 29, for example of elastomeric material, extending around the two rollers. The toothed belt 29 is enclosed within a tunnel 31 where it passes through the intermediate compartment 17 in order to prevent the ingress of debris into the rear compartment 3. The tunnel 31 may pass through the

intermediate compartment 17 at any convenient point. However, particularly in the event side wall 23 is removable for emptying purposes, the tunnel may be arranged at that side of the intermediate compartment 17 remote from the side wall 23.

The cleaning strip 2 as shown in Figure 4 comprises an elongate member 4 comprising a flexible material, for example rubber or a plastics material, with a substantially circular cross-section. Formed integral with the elongate member 4 are a series of spaced apart flexible tabs 6. Also formed integral with the elongate member 4 is a flexible strip 8 positioned along substantially the entire length of the elongate member. The thickness of the flexible strip 8 decreases progressively towards an edge furthest from the elongate member.

The flexible tabs 6 and the flexible strip 8 are positioned on the elongate member substantially at an angle relative to each other of approximately 45 degrees. The flexible tabs and flexible strip extend in a generally radial direction from the elongate member, and are directed, in use, towards the lower face of the body of the surface cleaning apparatus.

The elongate member of the cleaning strip is housed within a cavity (not shown) in the underside of the wall 15 of the surface cleaning apparatus so as to be rotatable about the axis of the elongate member. The cleaning strip is orientated such that the flexible strip is nearest to the front of the surface cleaning apparatus and the flexible tabs are nearer to the rear of the surface cleaning apparatus. The cavity comprises an open face through which the flexible strip and the flexible tabs protrude. The cavity has a first major wall, the rear wall in use, which

is substantially upright. The second major wall, the front wall in use, is inclined away from the rear wall at a nominal angle of 60 degrees. The inner face of the cavity, opposite the opening, comprises a concave curved surface  
5 wherein the curvature complements the curvature of the elongate member. The elongate member is retained within the cavity by retaining tabs attached to the rear wall of the cavity at the open face of the cavity. The cavity in the wall 15 is shaped such that excessive rotation of the  
10 elongate member in either direction is prevented by the walls of the cavity engaging the flexible tabs or flexible strip.

Figure 5 shows an alternative embodiment of the cleaning  
15 strip wherein the flexible strip has a first section 10 and a second section 12 positioned close to a first end 14 and to a second end 16 respectively of the elongate member 4 at which material of the flexible strip is absent such that an isolated portion 20 of the flexible strip is provided at the ends 14, 16 of the elongate member. In use,  
20 the isolated portions 20, in conjunction with restraining pins 18 present on the ends 14, 16 of the elongate member, impinge on retaining tabs of the cavity, such that the ends of the elongate member are prevented from being pulled  
25 towards each other during flexure of the elongate member.

A handle 33 is attached to the body 1 in the region of the rear compartment 3, the body being formed with a recess 35 beneath the handle to allow the handle to be gripped while  
30 maintaining a low profile for the surface cleaning apparatus. The handle 33 may be in two parts, a first part 37 which is secured to the body 1 and a second part 39 which can be removed from the first part and replaced by a longer handle part 41 as shown in Figure 6. The longer  
35 handle part 41 is provided with swivel means 43 to allow

the handle part 41 to rotate about the axis thereof relative to the body 1 and with pivot means 45 to allow the handle part to pivot about an axis transverse to the axial direction of the handle part to enable the surface cleaning  
5 apparatus to be steered by the user. As an alternative to interchangeable handles, the handle part 41 may be removably engageable with the handle part 33. In such a case, the handle part 33 is arranged such that the swivel means 43 functions only in certain positions of the handle  
10 part 33 in order that movement can be inhibited when the handle part 33 is used alone.

As will be apparent particularly from Figure 6, the bristles of the brush arrangement 11 extend outwardly from  
15 the aperture in the forward compartment 9. In order to remove stubborn debris and/or to revitalise carpet the lower front region of the forward compartment may be chamfered, or the front region of the forward compartment may be movable (including removable), to increase the  
20 exposure of the bristles in this region. In this way, the forward part of the apparatus may be inclined relative to the surface to be cleaned, thereby increasing contact between the bristles and a surface to be cleaned and, on some surfaces, increasing the depth to which the bristles  
25 penetrate and clean the surface.

Although not shown, an auxiliary rotary brush may be provided at that side of the brush arrangement 11 which incorporates the roller 27 and the belt 29. Such an  
30 auxiliary brush is described, for example, in GB-A-1 547 286. Such an auxiliary brush is able to sweep debris into the path of the brush arrangement 11 which might otherwise be missed due to the lack of bristles in the region of the roller 27. The auxiliary brush may be driven by any  
35 suitable means, such as gearing from the brush arrangement

11 or by friction with the surface to be swept, and is suspended from and extends outwardly beyond the body 1. The auxiliary brush may comprise a cylindrical body rotatable about an axis which is inclined to the vertical  
5 by about 10 degrees so as to extend outwardly beyond the body 1. Bristles protrude radially outwardly from the periphery of the cylindrical body, but need not be perpendicular to the axis of rotation and may preferably be at an angle of about 80 degrees to the axis of rotation so  
10 as to form a cone which increases in cross-section with increasing distance from the body 1.

Although not shown, the front part of the forward compartment 9 may be removed to expose the bristles at the  
15 front of the apparatus. This effectively increases the aperture in the forward compartment which would seriously impair the effectiveness of a suction cleaner, but in the present invention can effectively be used to assist in the sweeping of stairs, cleaning upholstery and carpets in  
20 vehicles and the like operations where a greater exposed area of bristles can be useful. As an alternative to removing the front part of the compartment 9, the front part may be movable, for example pivotable or slidable, relative to the remainder of the compartment in order to  
25 expose the bristles.

Although not shown, the rear compartment 3 may be provided with ground-engaging wheels in order to assist mobility of the surface cleaning apparatus. The ground-engaging wheels  
30 may, for example, be formed externally in the side regions of the rear compartment 3 or may be provided within recesses formed at least partly beneath the rear compartment 3.

Although the illustrated embodiments of the present invention are intended primarily for domestic use, the surface cleaning apparatus can also be used outdoors or in workshops if desired. However, it may be preferable to 5 provide a more rugged design specifically adapted for such use.

In use of the surface cleaning apparatus incorporating the cleaning strip according to the invention, as shown in 10 Figures 1 to 8, the surface cleaning apparatus is placed upon a surface to be swept, such as a carpet, and the switch operated to energise the motor and consequently to rotate the brush arrangement to sweep debris from the surface and then propel the debris up and over the inclined 15 wall 15 and into the intermediate compartment 17 where it is temporarily stored. As the surface cleaning apparatus is moved over the surface with the brush arrangement 11 rotating, any further debris is similarly swept from the surface and propelled up and over the wall 15 and into the 20 intermediate compartment 17. Figure 7 shows that the standard bristles 119, for example 14 mm long with an individual bristle diameter in a range from 0.12 mm to 0.25 mm and with a tuft diameter of nominally 3.0 mm, of the brush arrangement 11, support the surface cleaning 25 apparatus in use and are used to sweep the majority of the surface 104 to cleaned. The fine bristles, for example 15mm to 17 mm long with an individual bristle diameter of nominally 0.06 mm and with a tuft diameter of nominally 2.0 mm, of the brush arrangement 11, reach down into 30 irregularities in the floor surface, for example cracks and crevices, and remove any debris present and sweep it up into the intermediate compartment 17.

The cleaning strip 2 is used to ensure that efficient 35 cleaning of surfaces, for example hard floor surfaces, is

achieved. As shown in Figure 8a, when the surface cleaning apparatus is pushed forward 24 over a surface 104 to be cleaned, the flexible tabs 6 of the cleaning strip are dragged backwards by friction with the floor causing the  
5 elongate member 4 to rotate about its axis. Rotation of the elongate member brings the flexible strip 8 into contact with the floor. Continued forward movement of the surface cleaning apparatus results in the flexible strip being held in contact with the surface and particles of dirt 103 on  
10 the surface to be cleaned are gathered together and pushed forward along with the movement of the surface cleaning apparatus. Excessive rotation of the elongate member 4, when the surface cleaning apparatus is pushed forwards 24, is prevented by the rear face of the flexible strip  
15 engaging on the retaining tabs 22 which retain the elongate member within the cavity 32 of the wall 15. Further rotation is also prevented by the flexible tabs 6 engaging the rear wall 28 of the cavity 32.

20 Figure 8b shows, when the surface cleaning apparatus is moved in a rearward direction 26, the flexible strip 8 is dragged towards the front of the surface cleaning apparatus by friction with the surface 104 to be cleaned. In dragging the flexible strip forwards, the elongate member 4 of the  
25 cleaning strip is rotated such that the flexible tabs 6 are brought into contact with the floor 104. The flexible tabs 6 are also dragged towards the front of the surface cleaning apparatus so resulting in continued rotation of the elongate member and the subsequent lifting of the flexible strip clear of the floor. Excessive rotation of the elongate member is prevented by the flexible strip  
30 engaging the inclined front wall 30 of the cavity 32 in wall 15 and being stopped from further forward movement. When the surface cleaning apparatus is pulled in a rearward direction, the particles of dirt gathered together by the  
35

flexible strip during use in the forward direction are swept from the surface by the brush arrangement and propelled up and over the wall 15 and into the intermediate compartment 17. As the flexible strip is clear of the  
5 floor, additional particles of dirt can pass between adjacent flexible tabs and are not prevented from passing under the flexible strip.

The surface cleaning apparatus is extremely portable and  
10 can be employed wherever it may be required. For example, it can be used to sweep stairs without the need for electrical leads or suction hoses. The shape of the apparatus with the rounded shape of the rear compartment as illustrated facilitates movement of the apparatus over  
15 stairs, but ground engaging wheels may be provided to further facilitate such sweeping operations.

When the intermediate compartment 17 is to be emptied, one wall of the compartment is removed as explained above and  
20 the debris can readily be discharged. The removable wall is then replaced. Alternatively, the intermediate compartment may be in the form of a tray which can be removed and emptied so as to discharge debris.

25 When the surface cleaning apparatus is not in use it can be stored, for example either in a cupboard or the like or plugged into a mains supply in order to recharge the battery 7.

30 Thus the surface cleaning apparatus incorporating the cleaning strip of the present invention incorporates an electrically driven brush arrangement. The brush arrangement is not driven by frictional forces between the surface cleaning apparatus and the surface over which it is  
35 to be moved. Thus, efficiency of the apparatus is not

dependent on the nature of the frictional contact. Further, the apparatus does not rely on suction means to draw the debris into a storage chamber. Thus, efficiency of the apparatus is not dependent on the effectiveness of suction means and the substantial power drain of suction means on the rechargeable battery is avoided. The provision of the motor at the rear of the apparatus eliminates the need for increased height should the motor be positioned over the compartment for collecting dust and the like and also provides effective full width cleaning which would not be possible if the motor was to be positioned within the compartment for collecting debris. In such a position, debris is likely to accumulate around the motor and cause blockages. The present invention overcomes this problem by passing the drive means for the brush arrangement at least partly through the debris compartment.

Referring to Figures 9, 10 and 11, apparatus 102 for cleaning a surface 104 by sweeping comprises a housing 106, suitably of moulded plastics material, and effectively having three compartments. A rear compartment 108 houses an electric motor 110 and a rechargeable battery pack 112. The battery pack 112 may be connected to a mains power supply (not shown) for recharging the battery pack. The battery pack may either be connected to the mains supply whenever the apparatus is not in use or at suitable times when the battery pack has become depleted. Switch means 113 is provided to permit a user to energise and de-energise the motor 110 as desired. As an alternative to a rechargeable battery pack, the apparatus could employ disposable batteries or be mains powered.

A forward compartment 114 houses a transversely-arranged elongate rotatable brush arrangement 116, with bristles

118. Such elongate rotatable brush arrangement 116 is sometimes known as a brush bar. The length of the bristles on the brush arrangement 116, as described hereinbefore are, for example, in a range from 8 mm to 25 mm, preferably 5 a range from 14 mm to 17 mm. The thickness of individual bristles are in a range from 0.04 mm to 0.3 mm, preferably in a range from 0.06 mm to 0.25 mm. The bristles are arranged in tufts and the tufts have a diameter in a range from 1.5 mm to 5 mm, preferably in a range from 2 mm to 3 10 mm. The bottom of the forward compartment 114 is open at 120 to allow the bristles 118 of the elongate brush arrangement 116 to contact a floor, carpet or the like over which the apparatus is to be propelled. The rear of the forward compartment is a rearwardly inclined wall 122 which 15 allows debris, such as dust, dirt and the like to be propelled up the wall due to rotation of the brush arrangement 116 and to pass over the wall into an intermediate compartment 124. Mounted in and along the lower edge of the wall 122, behind the brush arrangement 20 116, is a cleaning strip, for example for cleaning hard floor surfaces, as described hereinbefore. The front of the forward compartment is provided with a cover (not shown) which may be removable if desired. Debris accumulating in the intermediate compartment 124 can be removed by opening 25 a cover 126. The wall 122 extends upwardly to about the same height as the top of the elongate brush arrangement 116 and may be angled rearwardly (i.e. away from the forward compartment) such as at an angle of about 18 degrees. The precise angle is not important, but the 30 inclination facilitates the passage of the debris up and over the wall 122 and at the same time facilitates retention of the debris within the intermediate compartment 124.

The elongate brush arrangement 116 is rotated by the motor 110 by way of toothed rollers 128, 130 attached to the motor and to the brush arrangement, respectively, and by way of a toothed belt 131, for example of elastomeric material, extending around the two rollers. The toothed belt 131 is enclosed within a tunnel 132 where it passes through or alongside the intermediate compartment 124 in order to prevent the ingress of debris into the rear compartment 108.

An auxiliary brush means 134 is provided extending outwardly from the housing 106 at the right hand side of the elongate rotatable brush arrangement 116 as viewed from above and behind the apparatus 102. The auxiliary brush means 134 is of substantially circular form and is supported for rotation about an axis 136, which may be vertical or inclined to vertical, such as at an angle of about 10 degrees to vertical. The auxiliary brush means 134 has a body 138 provided with radial bristles 140 which are inclined at an acute angle to the axis of rotation 136 so as to effectively form a conical arrangement increasing in cross-section with increasing distance from the body 138.

The auxiliary brush means 134 is rotatably driven from the rotating elongate brush arrangement 116 by a gear wheel 142 at the end of the elongate brush arrangement 116 which meshes with a further gear wheel 144 on the body 138 of the auxiliary brush means 134. The auxiliary brush means 134 is caused to be rotated in an anti-clockwise direction denoted by arrow 146, as viewed from above and behind the apparatus 102. During such rotation of the auxiliary brush means 134, a peripheral region thereof rotates from a sideways-directed position 148 (Figure 6) outside the housing 106 to an opposed sideways-directed position 150

covered by the housing 106, through a forwardly-directed position 152.

The cleaning strip 2 is used to ensure that efficient  
5 cleaning of surfaces, for example hard floor surfaces, is achieved. As described hereinbefore, when the surface cleaning apparatus is pushed forward 24 over a surface 104 to be cleaned, the flexible tabs 6 of the cleaning strip are dragged backwards by friction with the floor causing  
10 the elongate member 4 to rotate about its axis. Rotation of the elongate member brings the flexible strip 8 into contact with the floor. Continued forward movement of the surface cleaning apparatus results in the flexible strip being held in contact with the surface and particles of  
15 dirt 103 on the surface to be cleaned are gathered together and pushed forward along with the movement of the surface cleaning apparatus. Excessive rotation of the elongate member 4, when the surface cleaning apparatus is pushed forwards 24, is prevented by the rear face of the flexible  
20 strip engaging on the retaining tabs 22 which retains the elongate member within the cavity 32 of the wall 15. Further rotation is also prevented by the flexible tabs 6 engaging the rear wall 28 of the cavity 32.

25 When the surface cleaning apparatus is moved in a rearward direction 26, the flexible strip 8 is dragged towards the front of the surface cleaning apparatus by friction with the surface 104 to be cleaned. In dragging the flexible strip forwards, the elongate member 4 of the cleaning strip  
30 is rotated such that the flexible tabs 6 are brought into contact with the floor 104. The flexible tabs 6 are also dragged towards the front of the surface cleaning apparatus so resulting in continued rotation of the elongate member and the subsequent lifting of the flexible strip clear of  
35 the floor. Excessive rotation of the elongate member is

5 prevented by the flexible strip engaging the inclined front wall 30 of the cavity 32 in wall 122 and being stopped from further forward movement. When the surface cleaning apparatus is pulled in a rearward direction, the particles of dirt gathered together by the flexible strip during use in the forward direction are swept from the surface by the brush arrangement and propelled up and over the wall 122 and into the intermediate compartment 124. As the flexible strip is clear of the floor, additional particles of dirt can pass between adjacent flexible tabs and are not prevented from passing under the flexible strip.

10

15 The apparatus 102 is provided with a handle 154 by means of which it can be propelled at least in a forwards direction 156. Wheels 158 and 160 are provided to enable or assist manual propulsion of the apparatus across the surface 104 to be swept, such as a floor, stairway or upholstery. The handle 154 could be longer, or be of a different shape or form, as required.

20 25 The rotating auxiliary brush means 134 does not rely on contact with the surface 104 for its rotation and therefore provides more efficient sweeping of edge regions of the surface 104 regardless of the nature of the surface 104. Furthermore, the direction of rotation 146 of the auxiliary brush means 134 ensures that debris is swept positively by the auxiliary brush arrangement 134 into a position ahead of the rotating elongate rotating brush assembly 116, ready to be picked up by the elongate brush arrangement 116.

30 35 If desired, instead of or in addition to the auxiliary brush means 134 provided extending outwardly from the right hand side of the housing 106, a similar auxiliary brush means (not shown) could likewise be provided extending outwardly from the left hand side of the housing 106 and

driven from the opposite end of the elongate brush arrangement 116. Such additional or alternative auxiliary brush means differs from the auxiliary brush means 134 only in that it is caused to rotate in a clockwise, rather than 5 anti-clockwise, direction as viewed from above and behind the apparatus 102.

Instead of the apparatus 102 being provided with a battery or mains powered electric motor 110 to drive the elongate 10 brush arrangement 116 and hence the auxiliary brush means 134, a known form of friction drive means (not shown), resulting from propulsion of the apparatus 102 along the surface 104, may be utilised to effect rotation of the elongate brush arrangement 116 and hence rotation of the 15 auxiliary brush means 134.

An alternative embodiment of apparatus incorporating a cleaning strip according to the present invention is shown 20 in Figure 12. Such alternative embodiment comprises an upright vacuum cleaner apparatus 102A, having a housing 106A with wheels 158A and 160A, a rotating elongate brush arrangement 116A, and an auxiliary brush means 134A. The apparatus 102A is constructed in substantially similar 25 manner to the apparatus 102 of Figures 9, 10, and 11, with the main exception that instead of the debris-collecting compartment 124 of Figure 10, a debris-collecting container 124A, which may include a bag, is provided between a handle 154A and the housing 106A and connected by a well-known 30 form of suction arrangement (not shown) to the housing 106A.

A further embodiment of apparatus 102B according to the 35 present invention is shown in Figure 13. Here the housing 106B incorporates components similar to those of the housing 106 of Figures 9, 10 and 11 including wheels 158B

and, in particular, an elongate rotating brush arrangement 116B with an auxiliary rotating brush means 134B driven therefrom. However, no debris-collecting compartment is provided inside the housing 106B. Instead, the housing 106B is provided with a tubular portion 162 which is demountable on, or may be fixed to, a debris-receiving flexible hose 164 connected to a well-known form of suction vacuum cleaner 166, which may be of cylinder form, mounted on wheels 168. Electrical wiring 170 can be incorporated in the hose 164 by means of which mains electrical power can be supplied from the vacuum cleaner 166, and through a connector 172 and wiring 174 in the tubular portion 162, to an electric motor 110B where provided in the housing 106B for driving the elongate rotating brush arrangement 116B and the auxiliary brush means 134B. Of course, such wiring 170 would be unnecessary where the elongate brush arrangement 116B and the auxiliary brush means 134B driven therefrom, is caused to be rotated by the friction means previously described. Alternatively, the elongate brush arrangement 116B and the auxiliary brush means 134B may be caused to be rotated by means of a (rechargeable) battery or an air turbine driven by air passing along the tubular portion 162. The housing 106B with its included components could be provided as an accessory for existing vacuum cleaners of cylinder form.

Although the cleaning strip described hereinbefore is shown to comprise an elongate member with a substantially circular cross-sectional area attached to at least one tab and a strip member it should be appreciated that the cleaning strip may take other embodiments and the moving of the strip member relative to a floor may be achieved by other methods rather than by rotation of the elongate body of the cleaning strip.

Figure 14 shows another embodiment of a cleaning strip 202 which comprises an elongate member 204 of rigid material, for example plastics material, which is attached to a flexible strip 208, for example of a plastics or rubber material, positioned along substantially the entire length of the elongate member 204. The thickness of the flexible strip 208 decreases progressively towards an edge furthest from the elongate member. The thickness of the flexible strip is less than that of the elongate body such that a shoulder portion 210 is formed either side of the flexible strip where it is attached to the elongate member.

The flexible strip is directed, in use, towards the lower face of the body of the surface cleaning apparatus.

The elongate member of the cleaning strip is housed within the cavity (not shown) in the underside of the wall 15 of the surface cleaning apparatus so as to be movable in a substantially upright plane relative to the floor. The cavity also contains an arm 212 fixed at one end to a pivot pin 214 which can rotate about a fixed axis within the cavity. In use, the fixed axis of the pivot pin 214 is substantially parallel to the surface of the floor. The end of the arm 212 furthest from the pivot pin is positioned beneath a shoulder portion 210 of the cleaning strip. Also attached to the pivot pin 214 within the cavity are a number of flexible tabs 206. The free end of each tab 206, in use, is in contact with the floor 104.

The cavity comprises an open face through which the flexible strip and the flexible tabs protrude. The elongate member 204 is retained within the cavity by means of the arm 212 positioned below the shoulder portion 210 of the cleaning strip.

As shown in Figure 14a, when the surface cleaning apparatus is pushed forward 24 over a surface 104 to be cleaned, the flexible tabs 206 of the cleaning strip are dragged backwards by friction with the floor causing the arm 212 to 5 pivot about the fixed axis of the pivot pin 214 towards the floor. Pivoting of the arm away from the shoulder portion 210 of the cleaning strip allows the elongate member of the cleaning strip to lower and bring the flexible strip 208 into contact with the floor. Particles of dirt 103 on the 10 surface to be cleaned are gathered together by the flexible strip and pushed forward along with the movement of the surface cleaning apparatus.

Figure 14b shows, when the surface cleaning apparatus is moved in a rearward direction 26, the flexible tabs are 15 dragged towards the front of the surface cleaning apparatus by friction with the surface 104 to be cleaned. In dragging the flexible tabs forwards, the arm 212 pivots away from the floor about the fixed axis of the pivot pin 214. The 20 arm 212, positioned under the shoulder 210 of the cleaning strip, urges the cleaning strip in a substantially upward direction such that the flexible strip 208 is lifted clear of the floor.

When the surface cleaning apparatus is pulled in a rearward 25 direction, the particles of dirt gathered together by the flexible strip during use in the forward direction are swept from the surface by the brush arrangement. As the flexible strip is clear of the floor, additional particles 30 of dirt can pass between adjacent flexible tabs and are not prevented from passing under the flexible strip.

Figure 15 shows a further embodiment of the cleaning strip, wherein the cleaning strip comprises an elongate member 204 35 of rigid material, for example plastics material, which is

attached to a flexible strip 208 positioned along substantially the entire length of the elongate member. The thickness of the flexible strip 208 decreases progressively towards an edge furthest from the elongate member. The 5 thickness of the flexible strip is less than that of the elongate body such that a shoulder portion 210 is formed either side of the flexible strip where it is attached to the elongate member.

10 The cavity also contains a first arm 212 fixed at one end to a pivot pin 214 which can rotate about a first fixed axis within the cavity. The end of the first arm 212 furthest from the pivot pin 214 is positioned beneath a shoulder portion 210 of the cleaning strip. Also attached 15 to the pivot pin within the cavity are a number of flexible tabs 206. The free end of each tab 206, in use, is in contact with the floor 104.

20 Attached to the elongate body 204 is a second arm 216 which connects the cleaning strip 202 to a second pivot pin 218 within the cavity in the wall of the surface cleaning apparatus. The elongate member of the cleaning strip is housed within the cavity of the surface cleaning apparatus so as, when in use, to be pivotably moved on the second arm 25 216 relative to the floor about an axis of the second pivot pin 218 substantially parallel with the surface of the floor.

30 The cavity comprises an open face through which the flexible strip and the flexible tabs protrude. The elongate member is retained within the cavity by means of the first arm 212 positioned below the shoulder portion 210 of the cleaning strip and by means of the second arm 216 attaching the cleaning strip to the second pivot pin 218.

When the surface cleaning apparatus is pushed forward 24 over a surface 104 to be cleaned, the flexible tabs 206 of the cleaning strip are dragged backwards by friction with the floor causing the first arm 212 to pivot towards the floor about the axis of the first pivot pin 214. Pivoting of the first arm 212 allows the elongate member of the cleaning strip to pivot on the second arm 216 about the axis of the second pivot pin 218 and so bring the flexible strip 208 into contact with the floor. As described hereinabove, particles of dirt 103 on the surface to be cleaned are gathered together by the flexible strip and pushed forward along with the movement of the surface cleaning apparatus.

When the surface cleaning apparatus is moved in a rearward direction the flexible tabs are dragged towards the front of the surface cleaning apparatus by friction with the surface 104 to be cleaned. In dragging the flexible tabs forwards, the first arm 212 pivots away from the floor about the axis of the first pivot pin 214. The first arm, positioned under the shoulder 210 of the cleaning strip, urges the cleaning strip in a substantially upward direction such that the flexible strip is lifted clear of the floor and pivots, via the second arm 213, about the axis of the second pivot pin 218.

When the surface cleaning apparatus is pulled in a rearward direction, the particles of dirt gathered together by the flexible strip during use in the forward direction are swept from the surface by the brush arrangement. As the flexible strip is clear of the floor, additional particles of dirt can pass between adjacent flexible tabs and are not prevented from passing under the flexible strip.

It should be understood that an alternative to the flexible tabs described hereinabove could be a friction wheel 220, as shown in Figure 16, whereby movement of the friction wheel 220 relative to the floor can be used to cause an arm 5 212 beneath the shoulder portion 210 of the cleaning strip to be moved thus raising and lowering the cleaning strip as described hereinabove.

It should be understood that electronic or other means may 10 be used in place of frictional means to determine the movement of the surface cleaning apparatus and for controlling the positioning of the flexible strip.

Although the rotatable brush arrangement hereinbefore is 15 shown to comprise rows of tufts of bristles attached to a cylindrical member wherein the tufts all extend substantially radially from the cylindrical member and as such only sweep an area of surface below the cylindrical body of the brush apparatus and as such only an area below 20 the body of the surface cleaning apparatus it should be appreciated that the rotatable brush arrangement may take other embodiments to provide means of cleaning an area of surface beyond the end of the cylindrical body of the rotatable brush apparatus, and preferably alongside the 25 surface cleaning apparatus.

Figure 17 shows another embodiment of a rotatable brush arrangement 302 which comprises a cylindrical elongate body 304 and tufts of bristles 306. The tufts of bristles are 30 arranged as two helically arranged rows. The two rows are diametrically opposed and each row is in the form of a pair of separate helices which twist in opposite directions and meet substantially midway between the ends of the brush arrangement. In general the tufts are arranged to extend 35 radially from the cylindrical member.

The length of the bristles, for example, are in a range from 8 mm to 25 mm, preferably a range from 14 mm to 17 mm. The thickness of individual bristles are in a range from 0.04 mm to 0.3 mm, preferably in a range from 0.06 mm to 0.25mm. The tufts have a diameter in a range from 1.5 mm to 5 mm, preferably a range from 2 mm to 3 mm.

Tufts of bristles 308 positioned at the ends of the cylindrical member 304, the end-most bristles, are arranged such that they are directed towards the nearest end of the cylindrical member and, if unrestrained, extend beyond the end. In use the end-most bristles will contact an area of surface alongside the surface cleaning apparatus in which the rotatable brush arrangement is housed.

Figure 18 shows a side of the housing 310, in which the brush arrangement rotates, with an opening 312 through which the end-most bristles 308 (not shown) protrude when in line with the aperture.

As the brush arrangement is rotated, successive tufts of the bristles 308 positioned at the end of the cylindrical member pass the front wall 314 of the opening and align with the opening itself. When in alignment with the opening, the end-most bristles are no longer restrained by the housing wall 316 and the end-most bristles move axially of the cylindrical member to extend outwards through the opening and contact the surface alongside the surface cleaning apparatus. As the brush assembly continues rotating the end-most bristles will rotate rearwards until they contact the rear wall 318 of the opening. At the point of rotation of the brush assembly, when the end-most bristles contact the rear wall, the bristles are deflected axially inwards by the wall such that further rotation leads to the bristles being pulled inside the housing

again. The action of the end-most bristles being deflected back inside the housing results in particles of dirt in the area of surface alongside the surface cleaning apparatus also being swept into the area below the housing and being 5 swept up by the radially arranged bristles 306 of the brush assembly 302.

In order to facilitate the deflection of the end-most bristles back into the housing, the rear wall of the 10 opening can be contoured to provide a surface curving inwards along which the end-most bristles are moved as the brush assembly rotates.

THIS PAGE BLANK (USPTO)

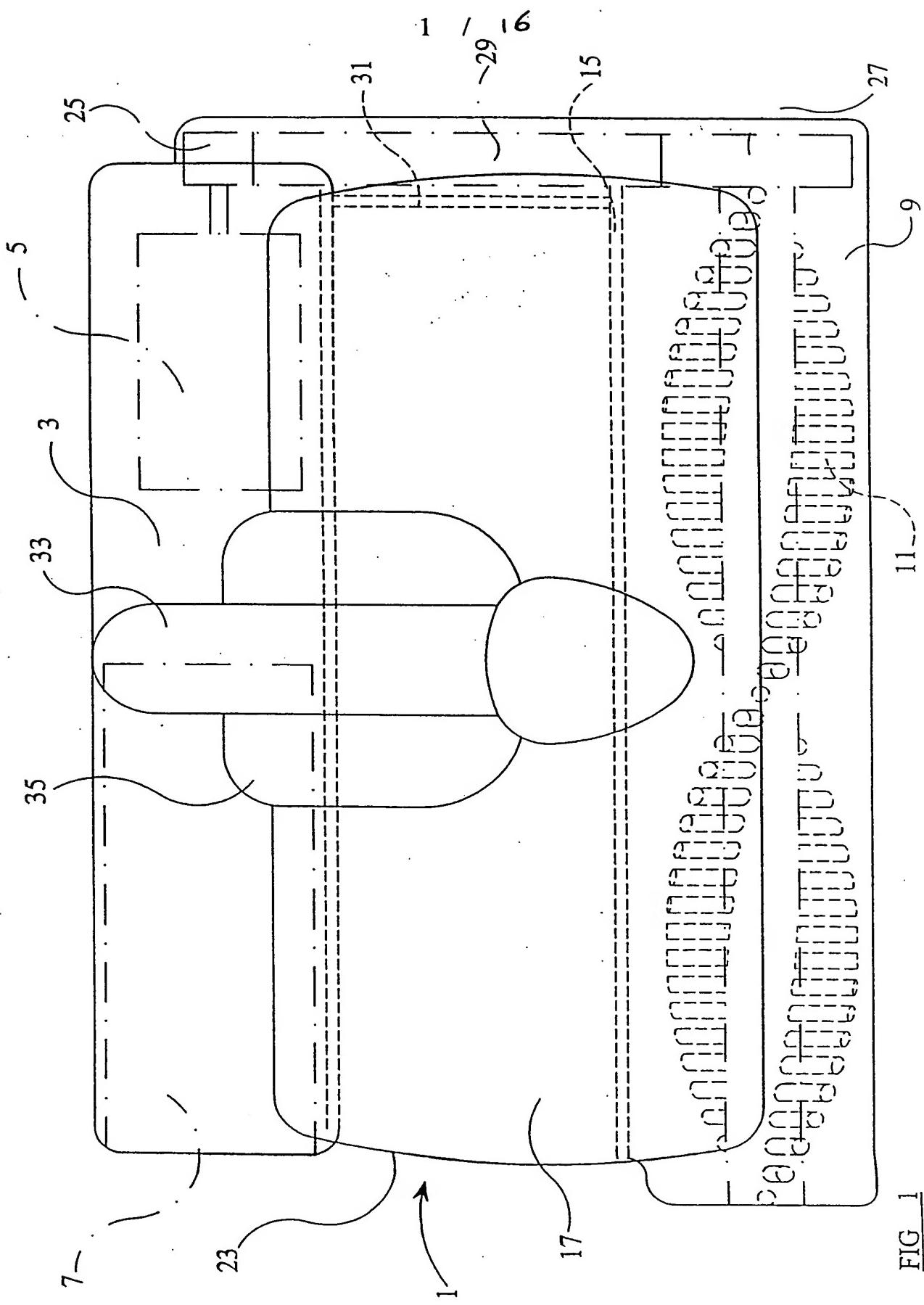


FIG 1

THIS PAGE BLANK (USPTO)

2 / 16

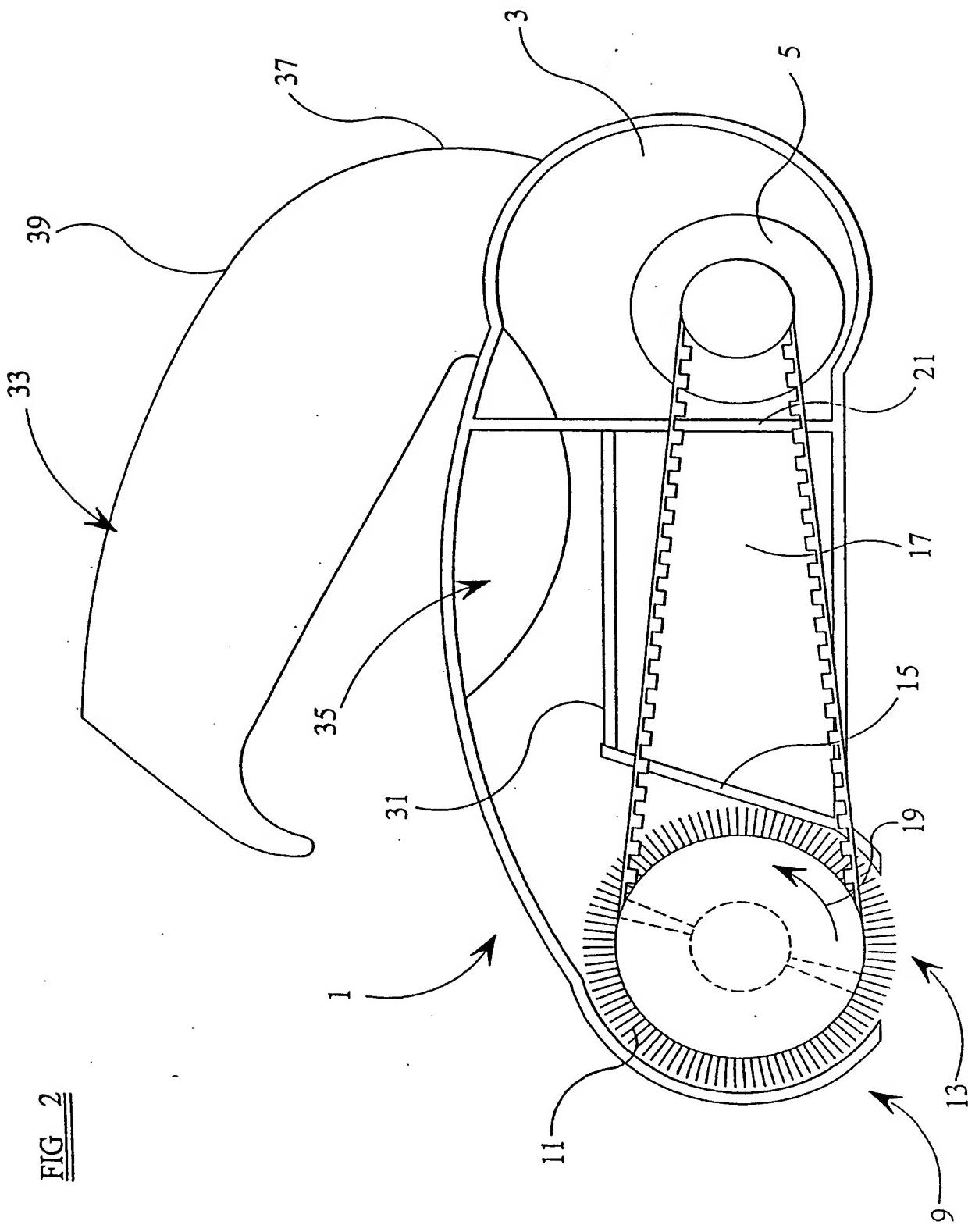
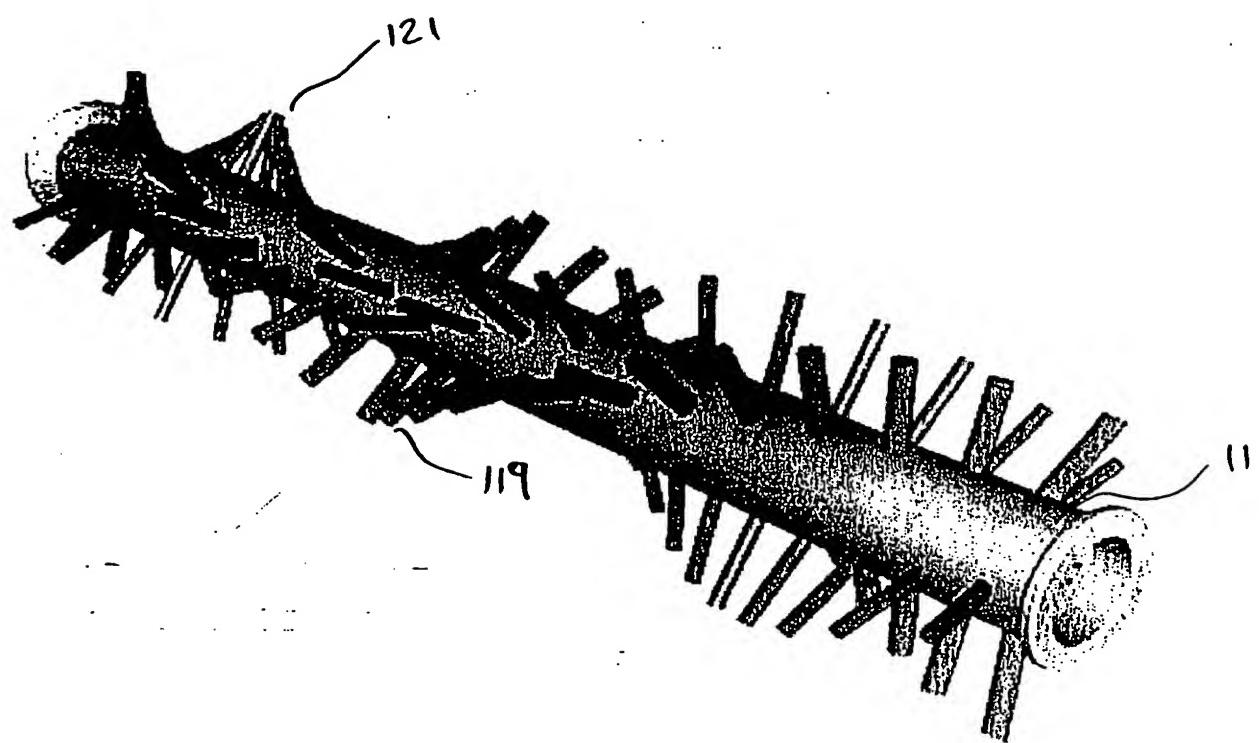


FIG 2

**THIS PAGE BLANK (USPTO)**

3/16

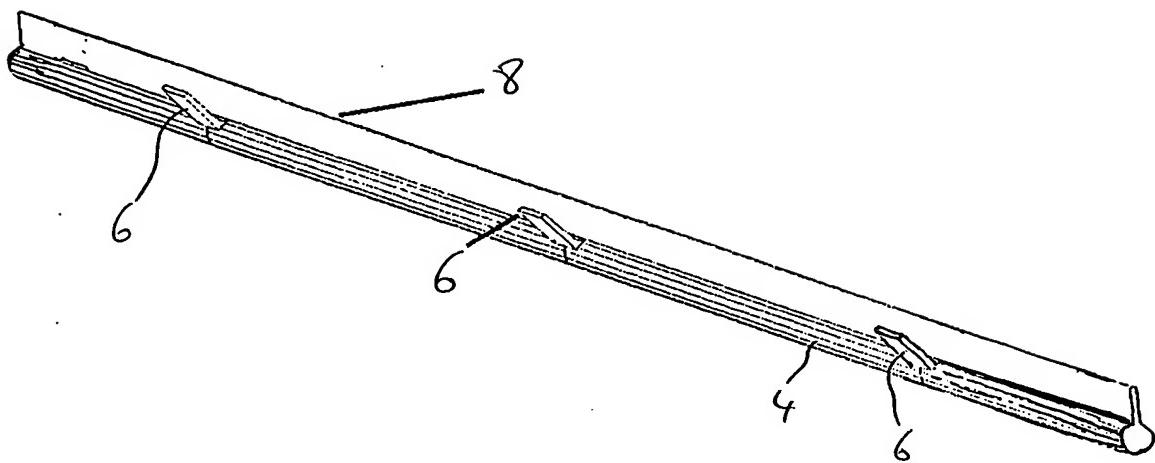
FIGURE 3



THIS PAGE IS A WORK PRODUCT OF THE U.S. PATENT AND TRADEMARK OFFICE (USPTO)

4 / 16

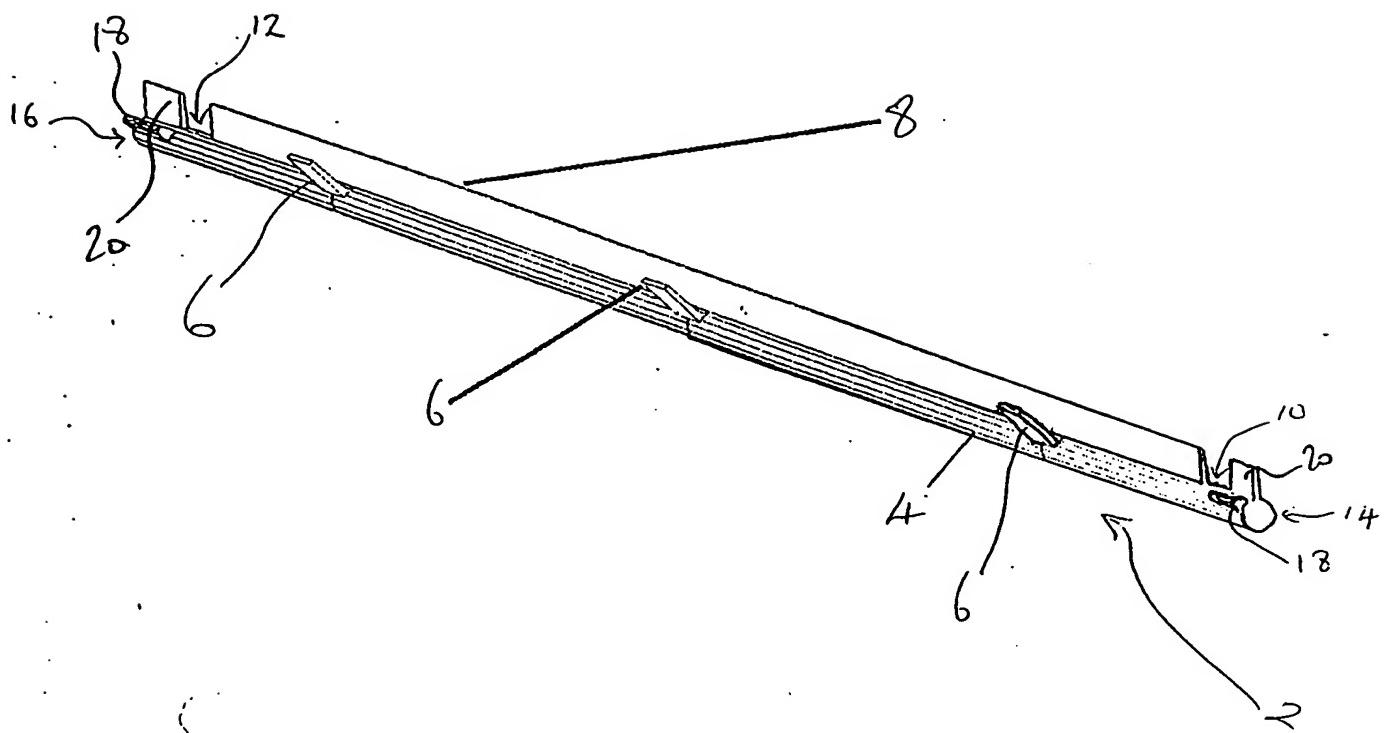
FIGURE 4



THIS PAGE IS DRAFT (USPTO)

5116

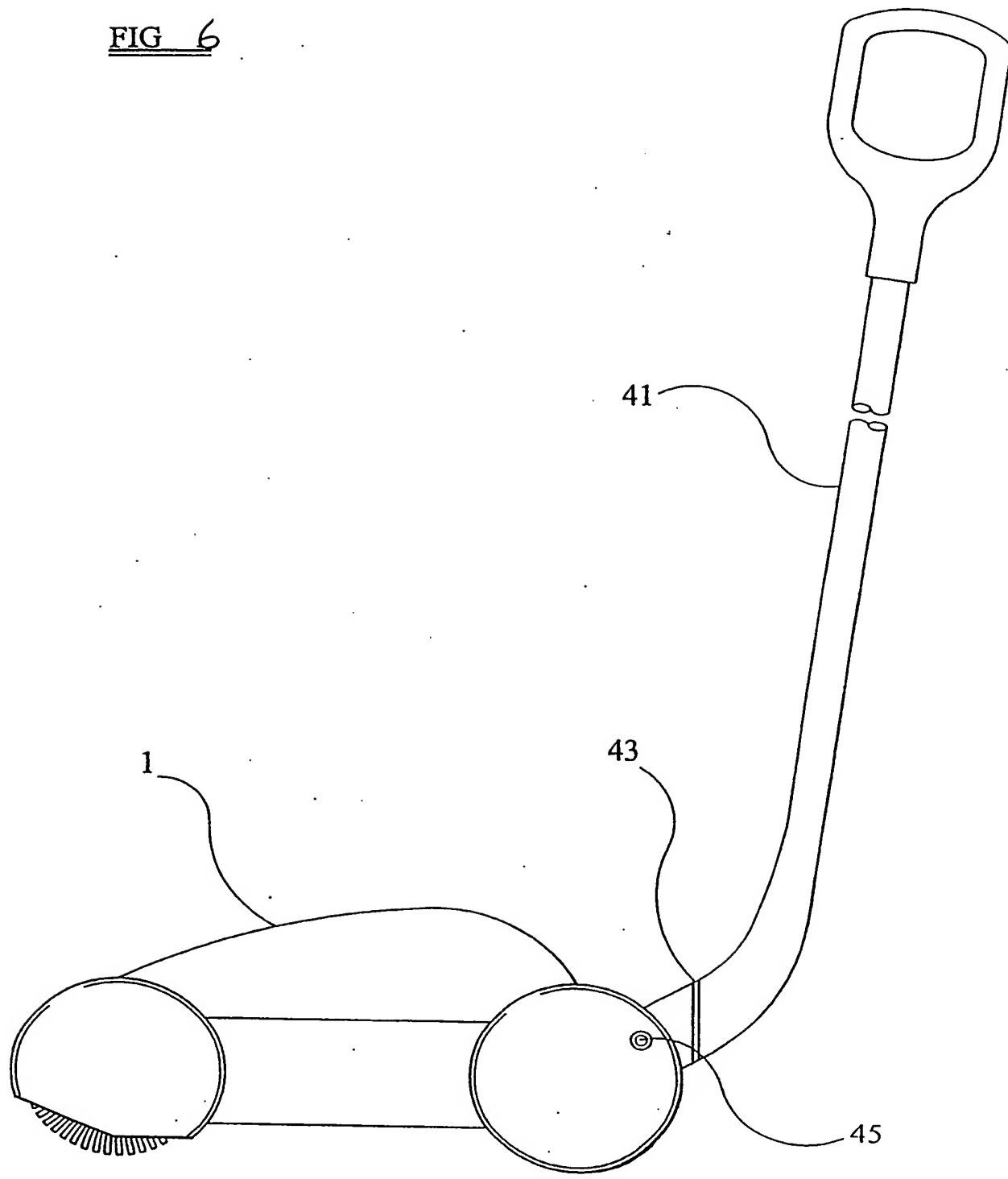
FIGURE 5.



THIS PAGE BLANK (USPTO)

61,6

FIG 6



THIS PAGE BLANK (USPTO)

7/16

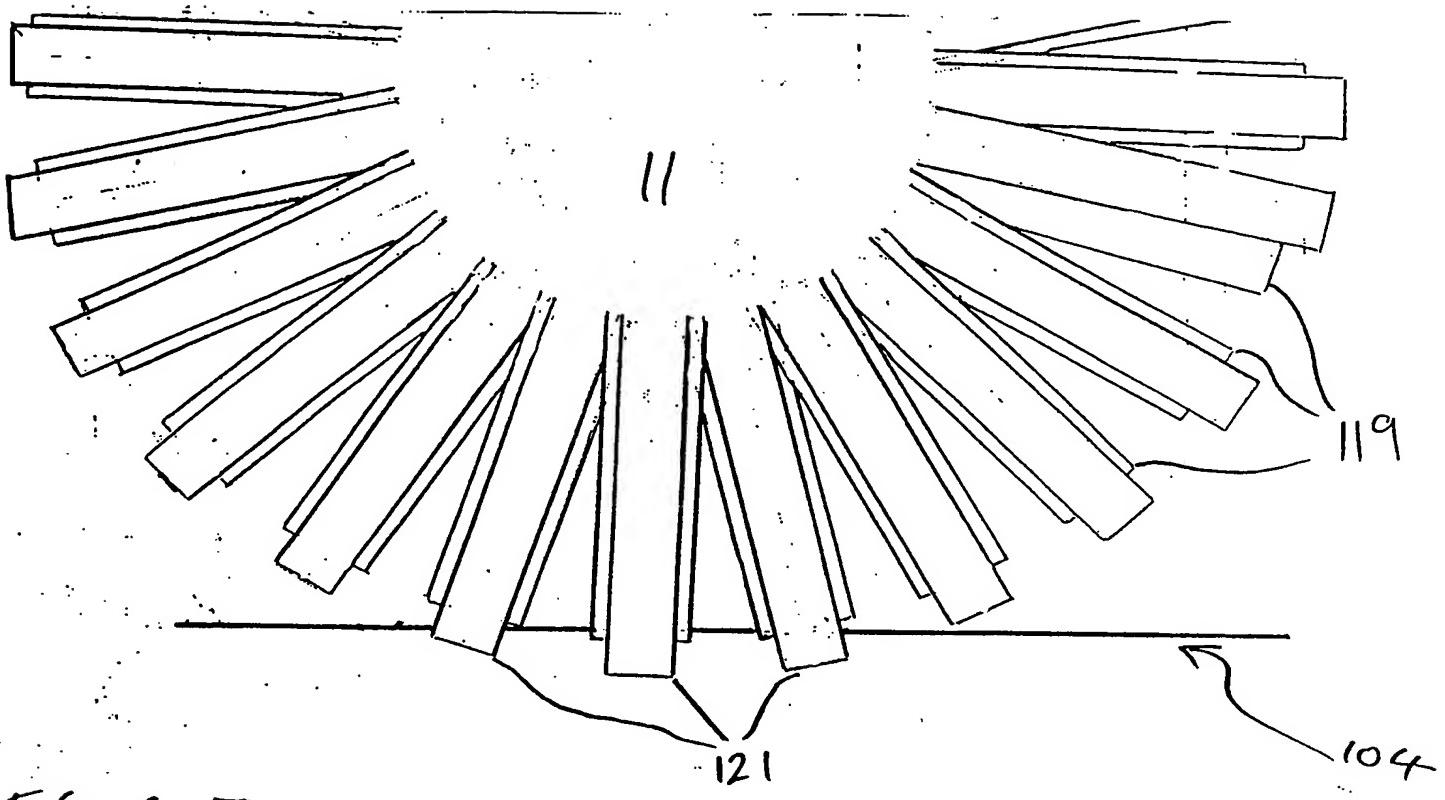


FIGURE 7

~~SECRET~~ PAGE BLANK (UNPTO)

8/16

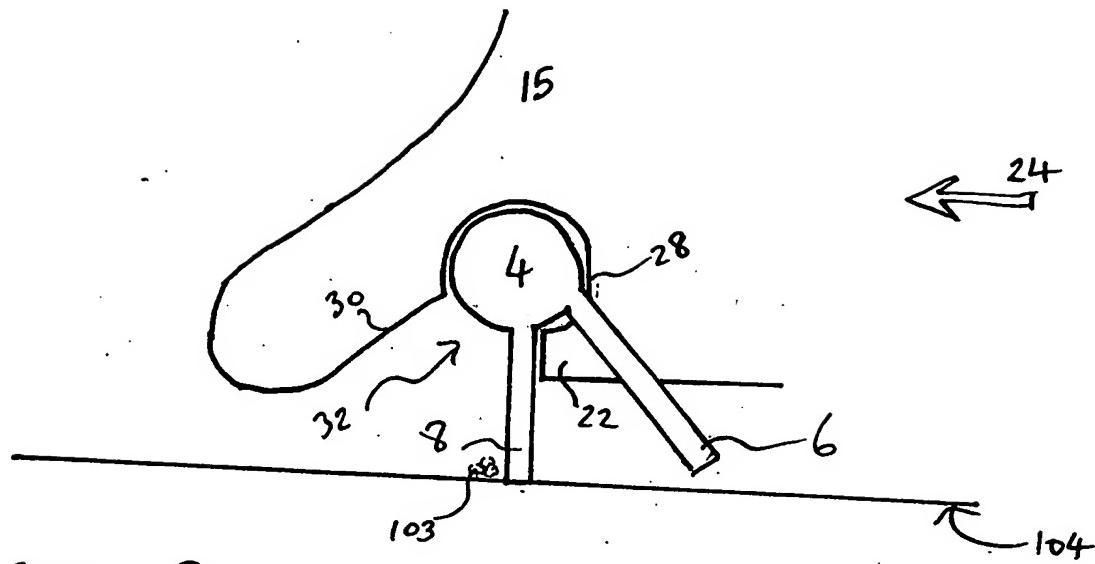


FIGURE 8a

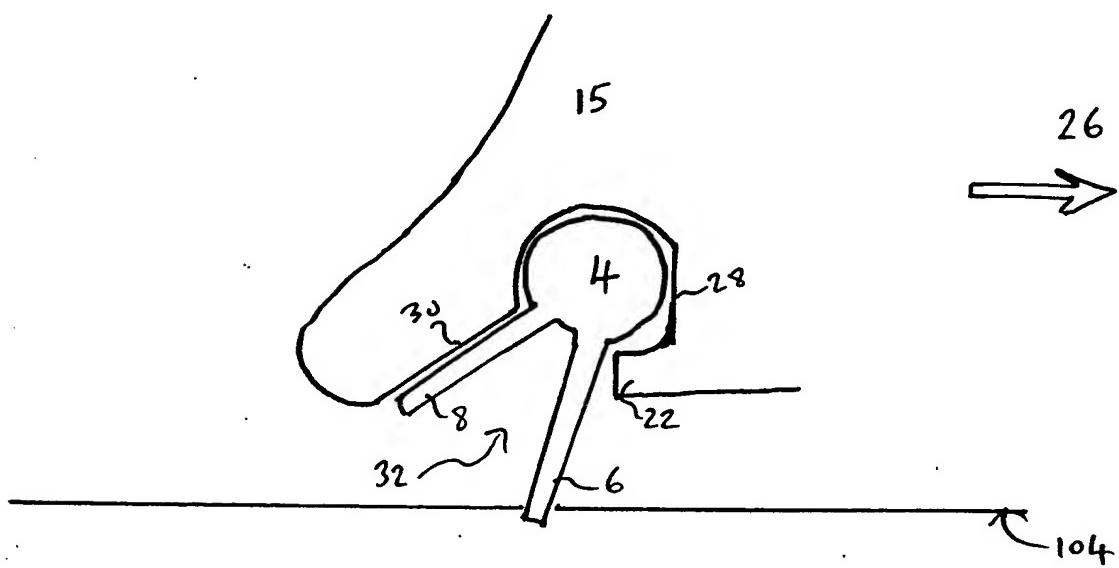
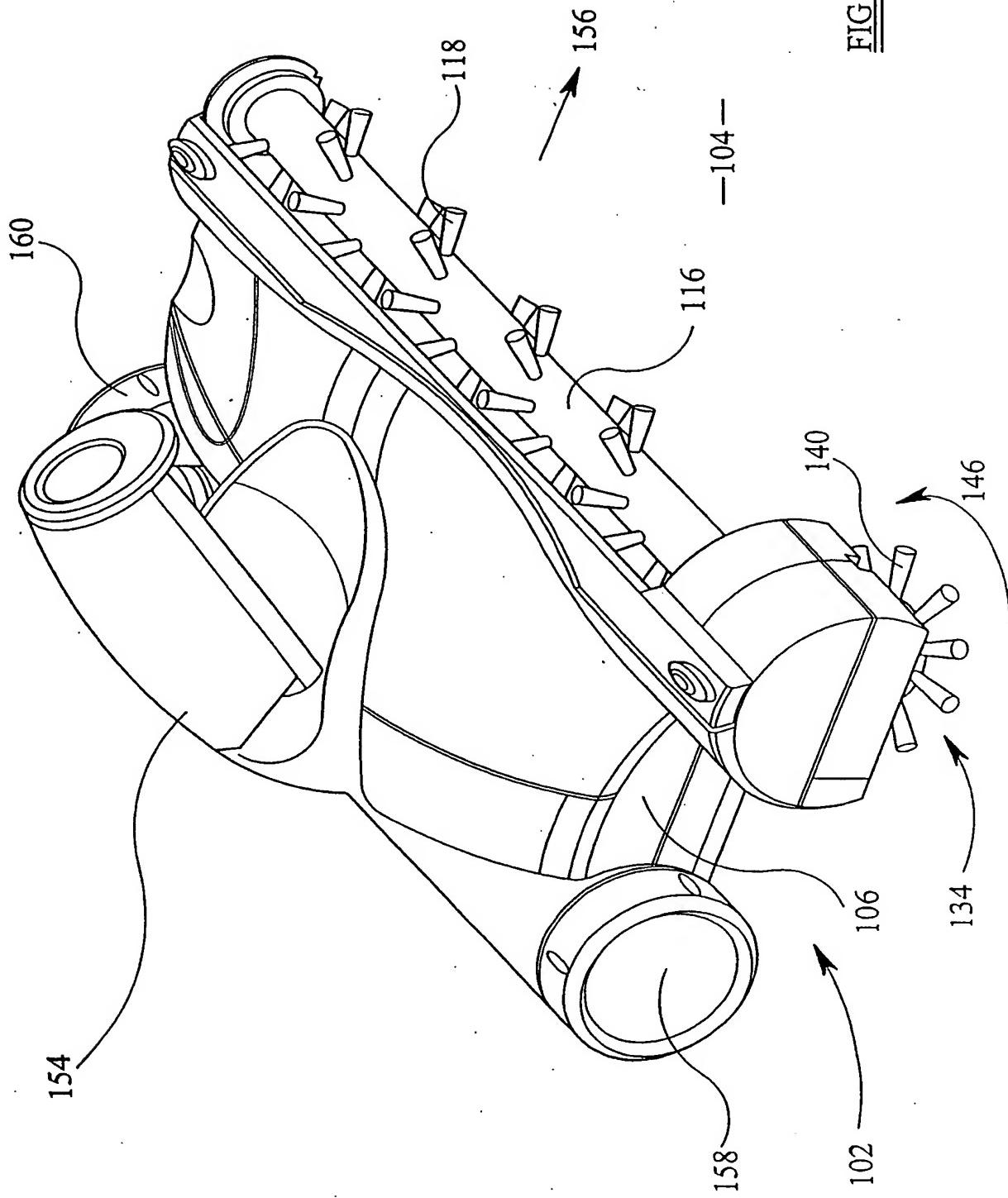


FIGURE 8b

PAGE BLANK (USPTO)

FIG 9

PAGE BLANK (USPTO)

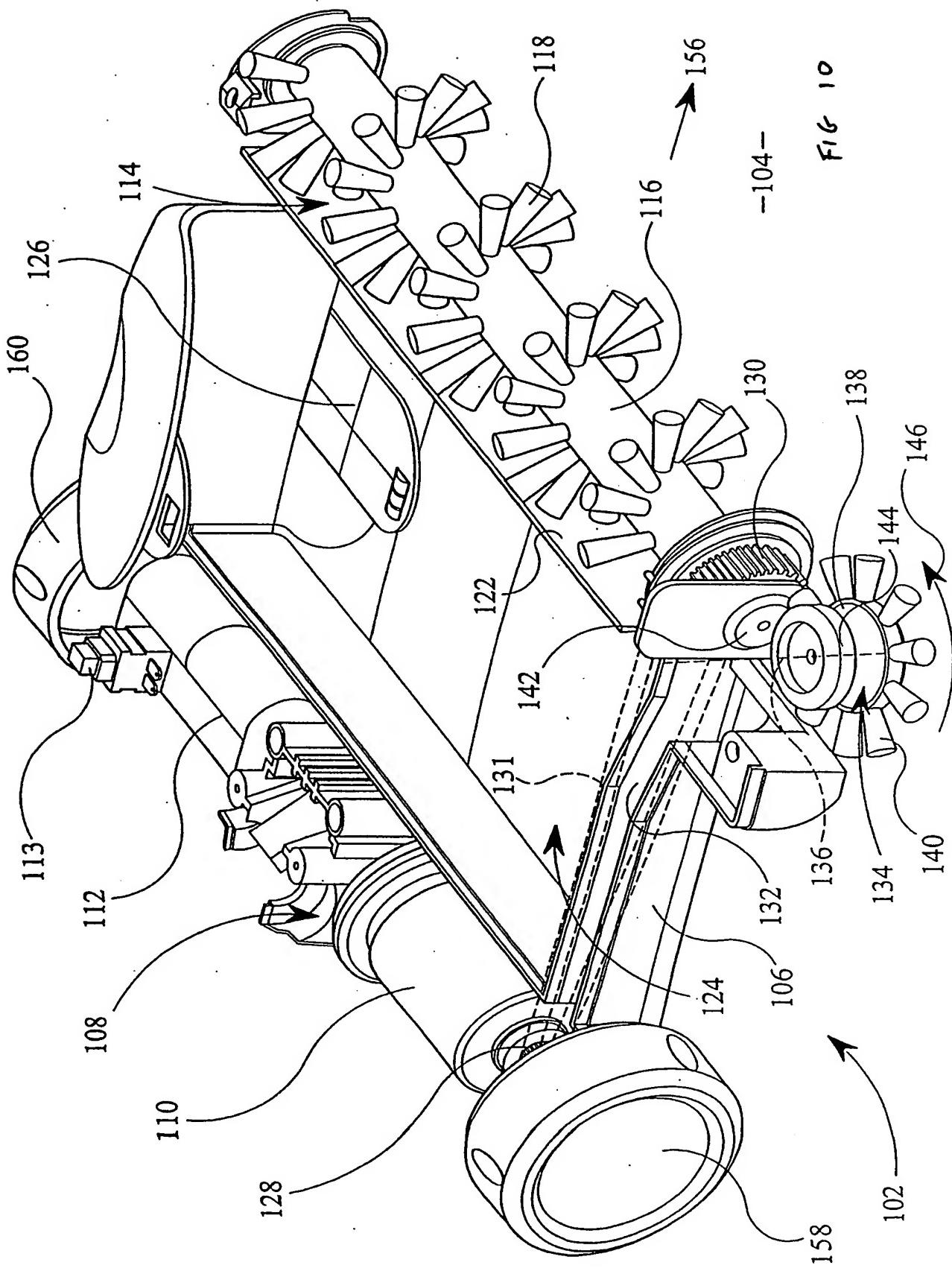
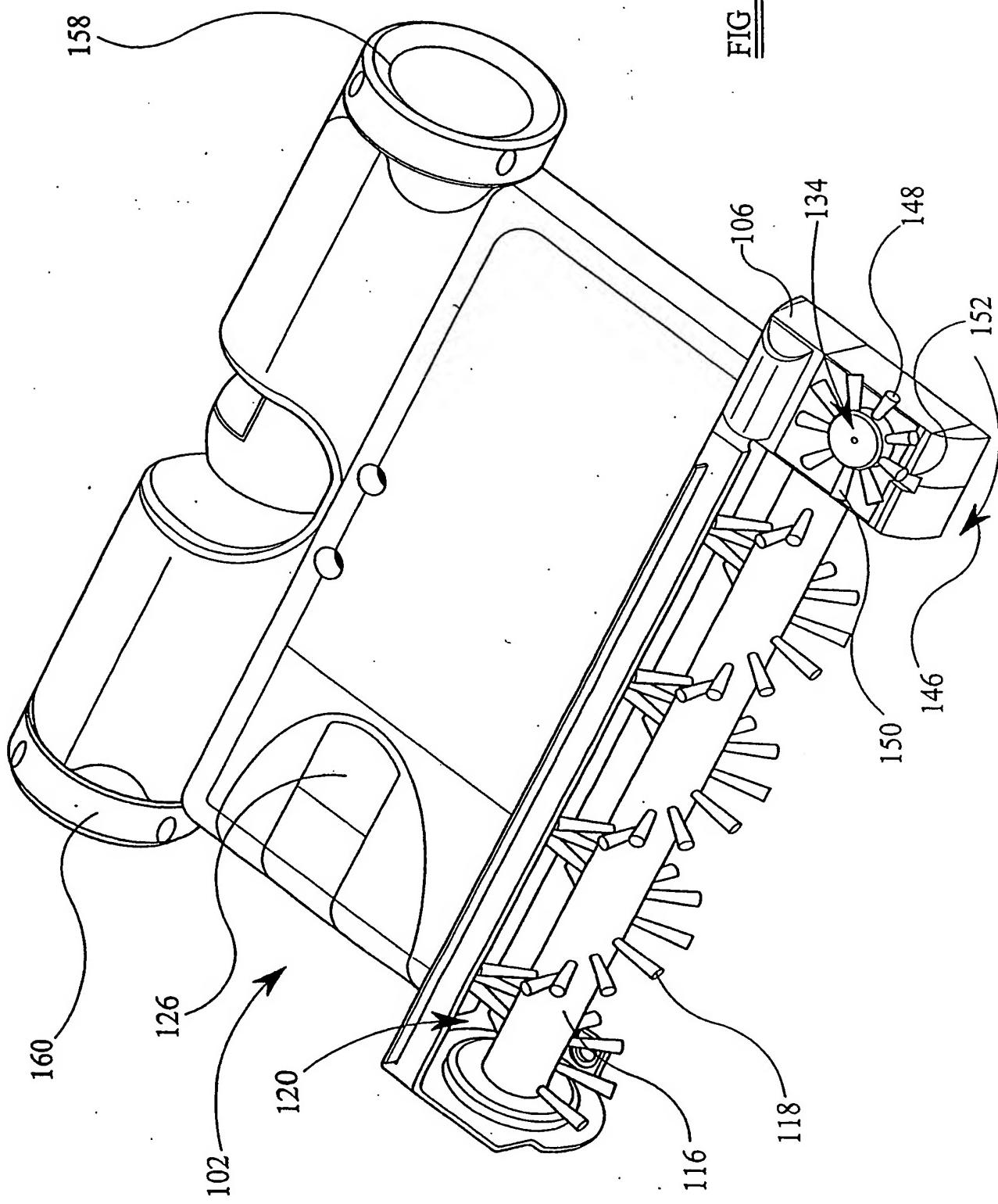


Fig 10

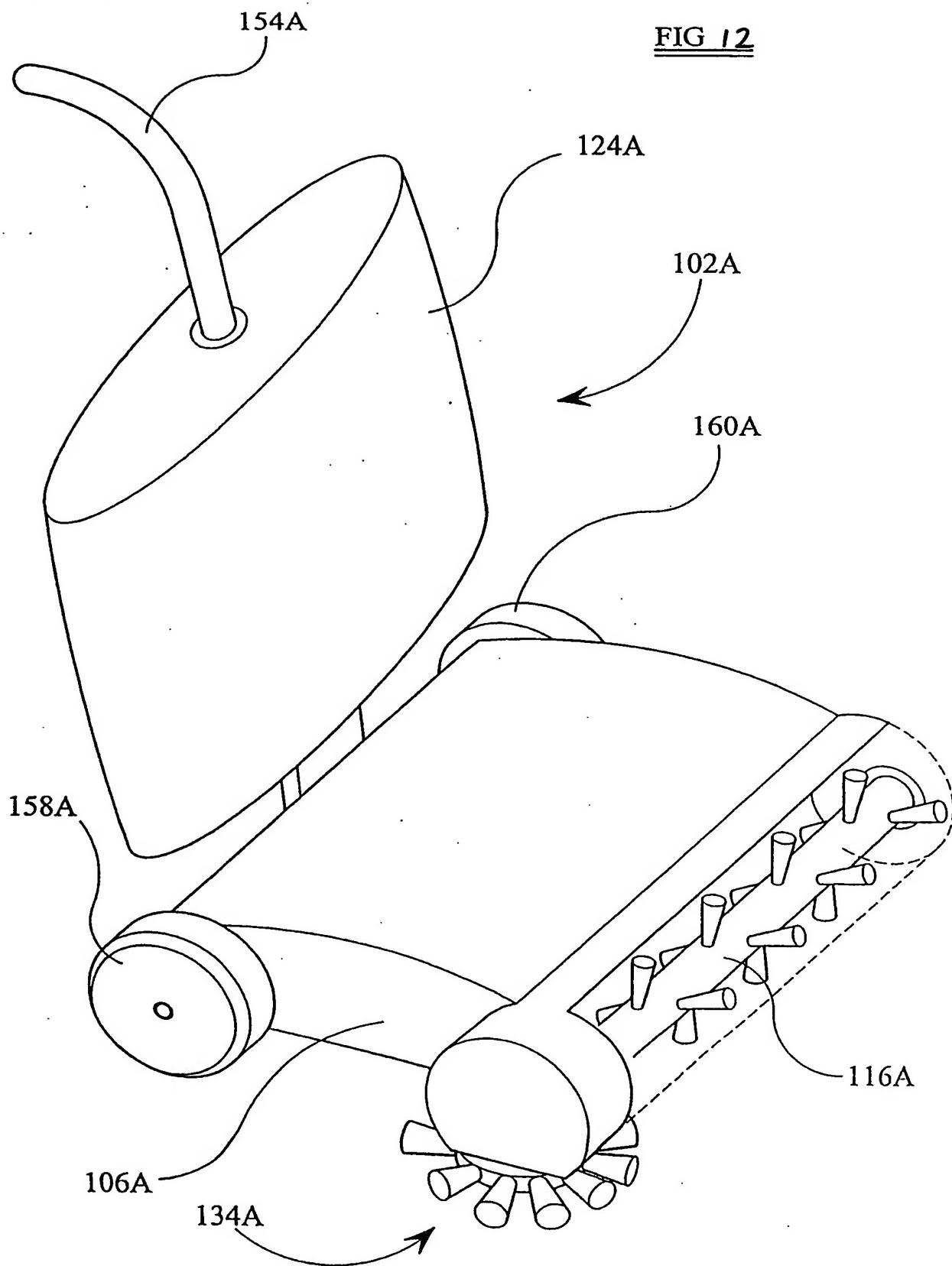
**THIS PAGE BLANK (USPTO)**

11 / 16

FIG 11

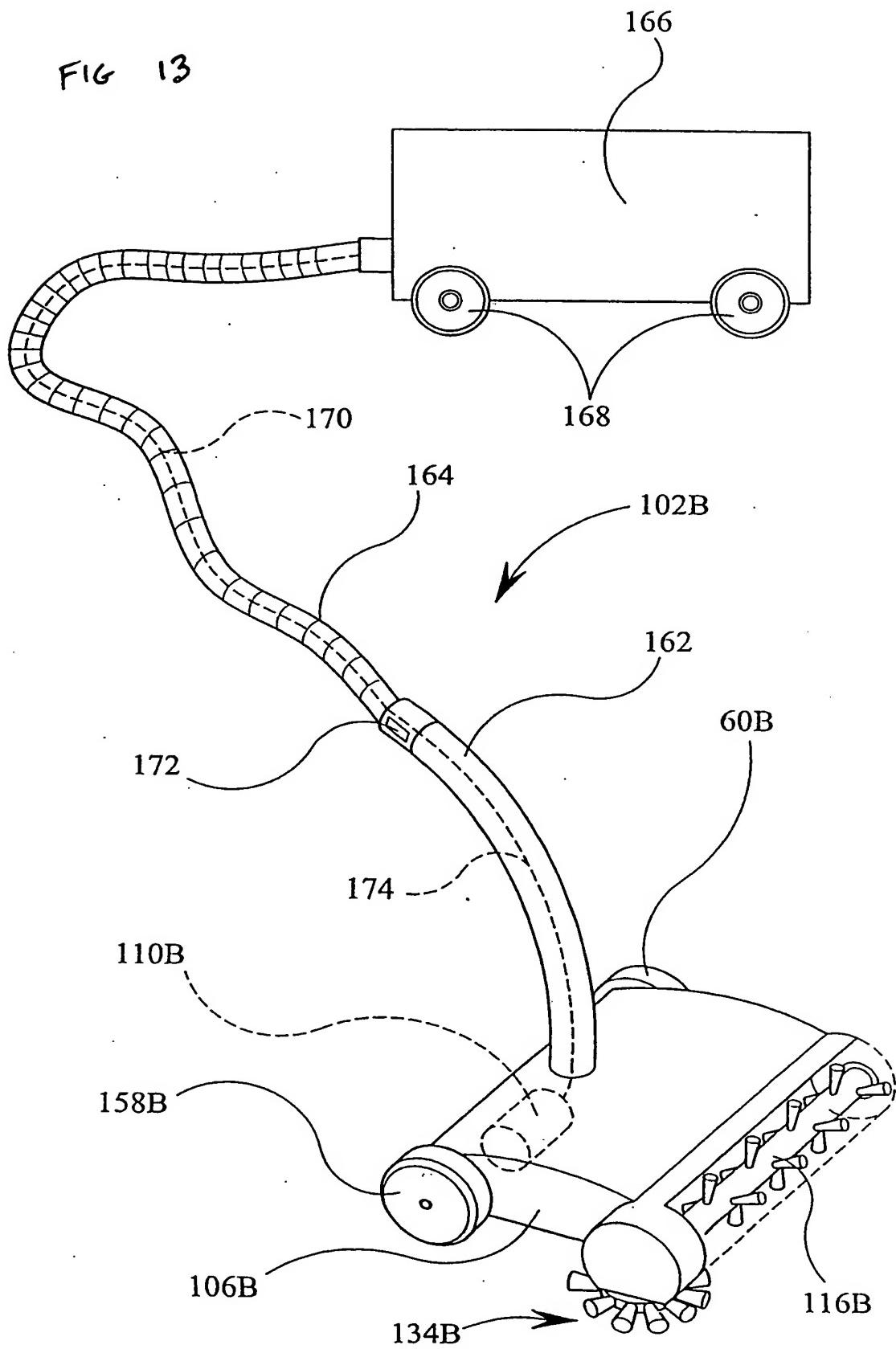


**THIS PAGE BLANK (USPTO)**



**THIS PAGE BLANK (USPTO)**

FIG 13



**THIS PAGE BLANK (USPTO)**

**THIS PAGE BLANK (USPTO)**

14 / 16

FIG 14 a

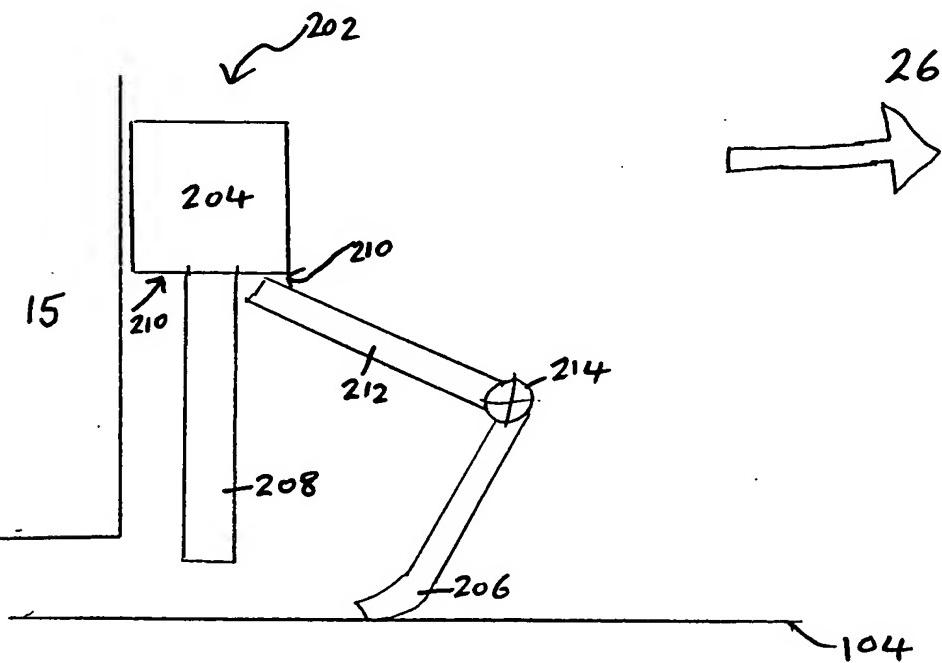
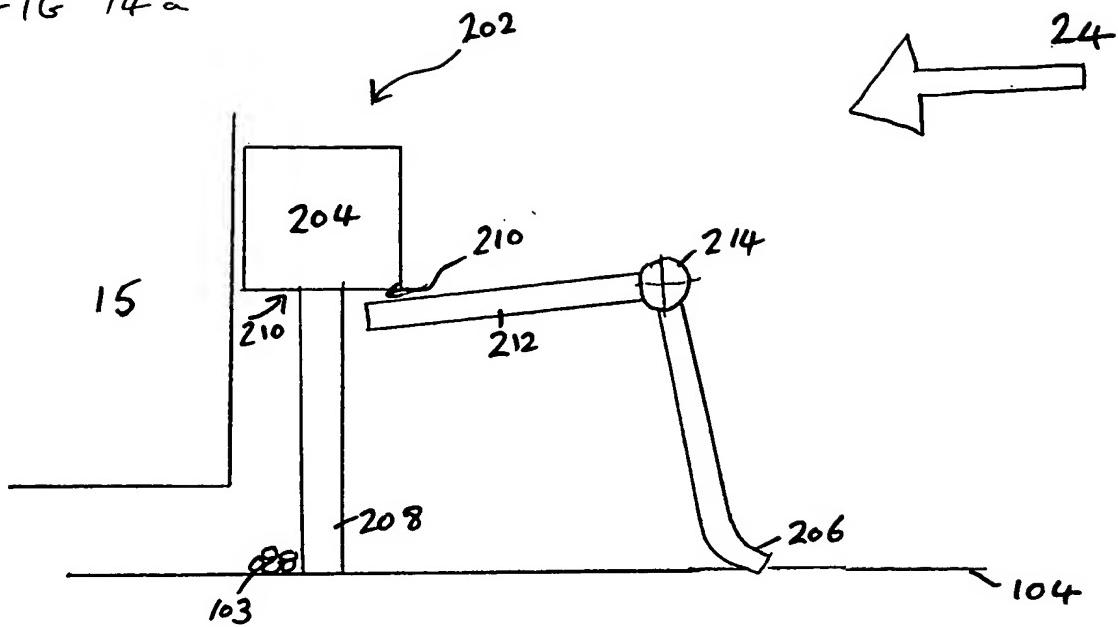


FIG 14 b

THIS PAGE BLANK (USPTO)

FIG 15

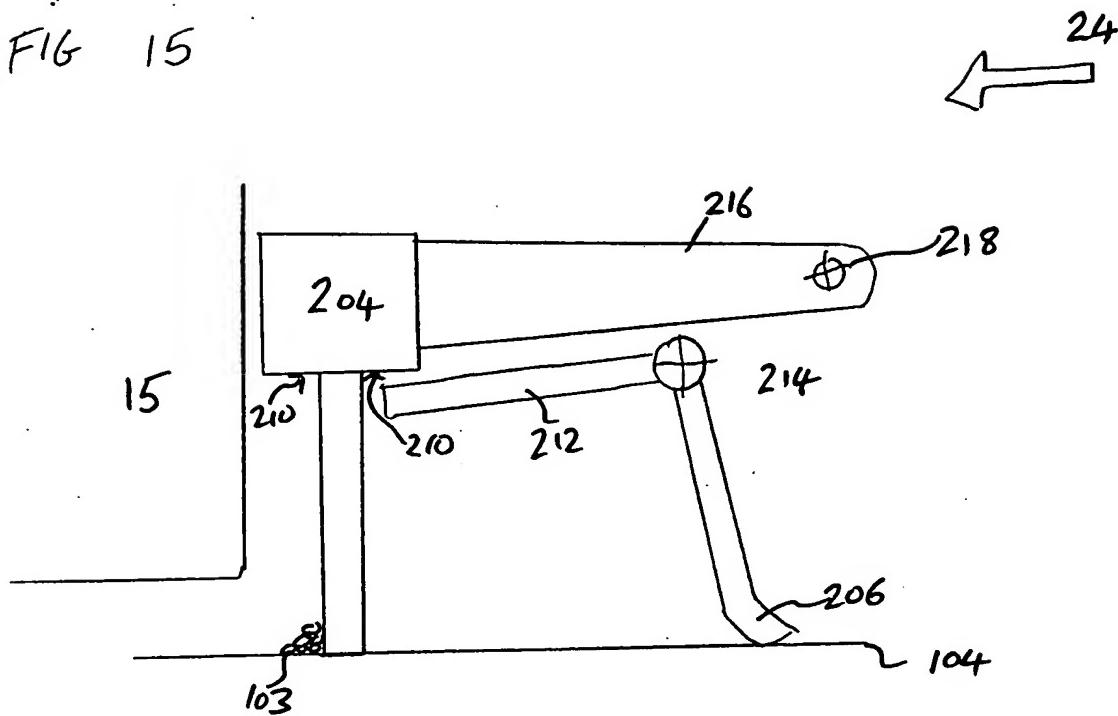
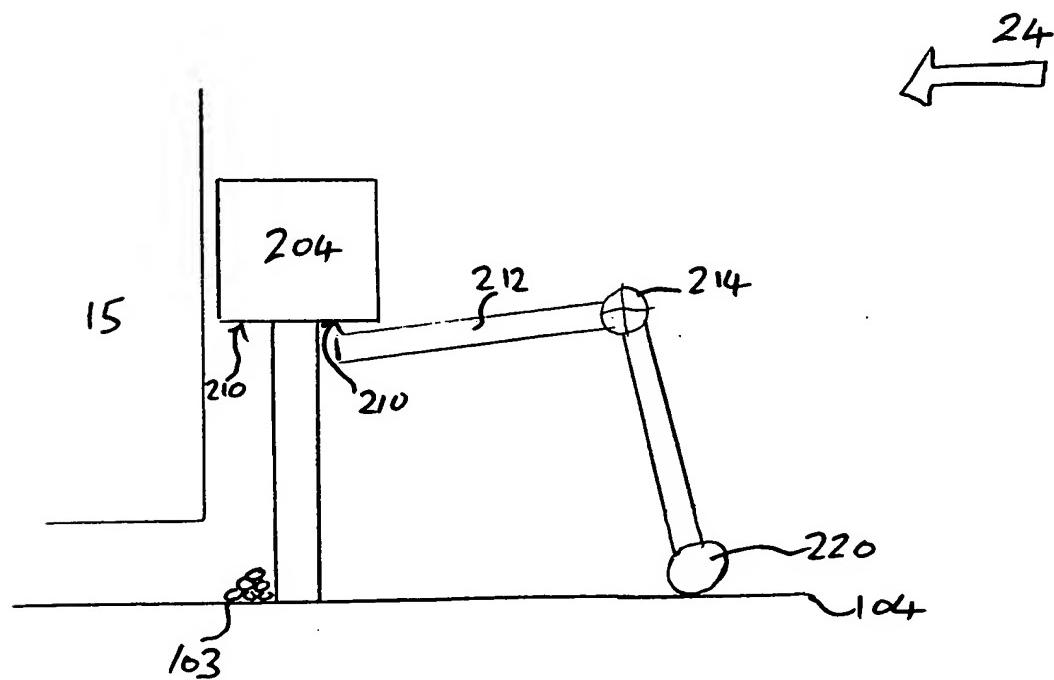


FIG 16



**S PAGE BLANK (USPTO)**

16/16

FIG 17

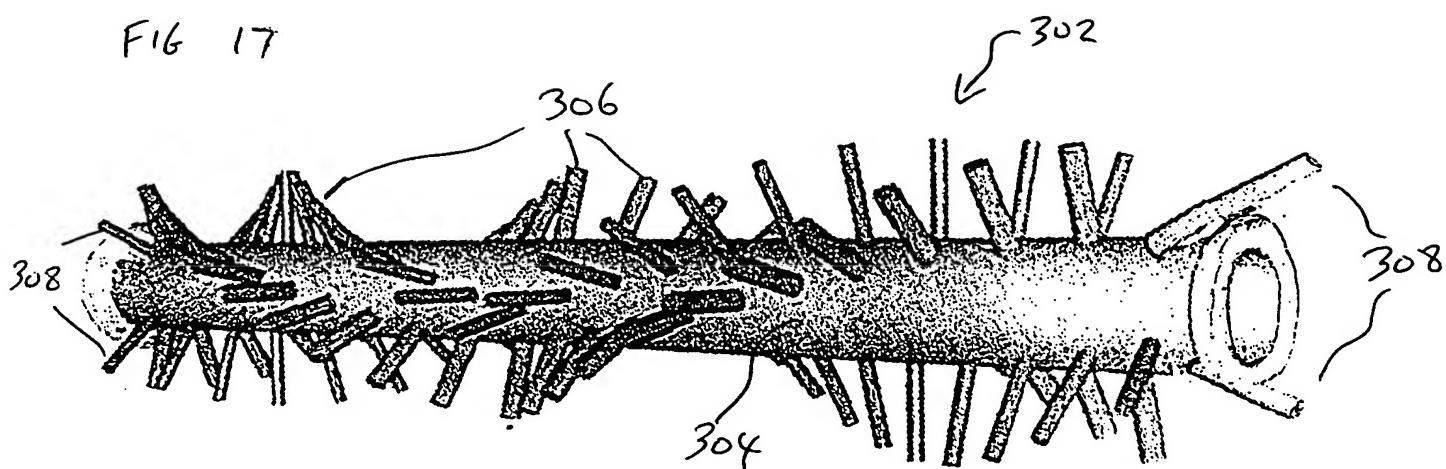
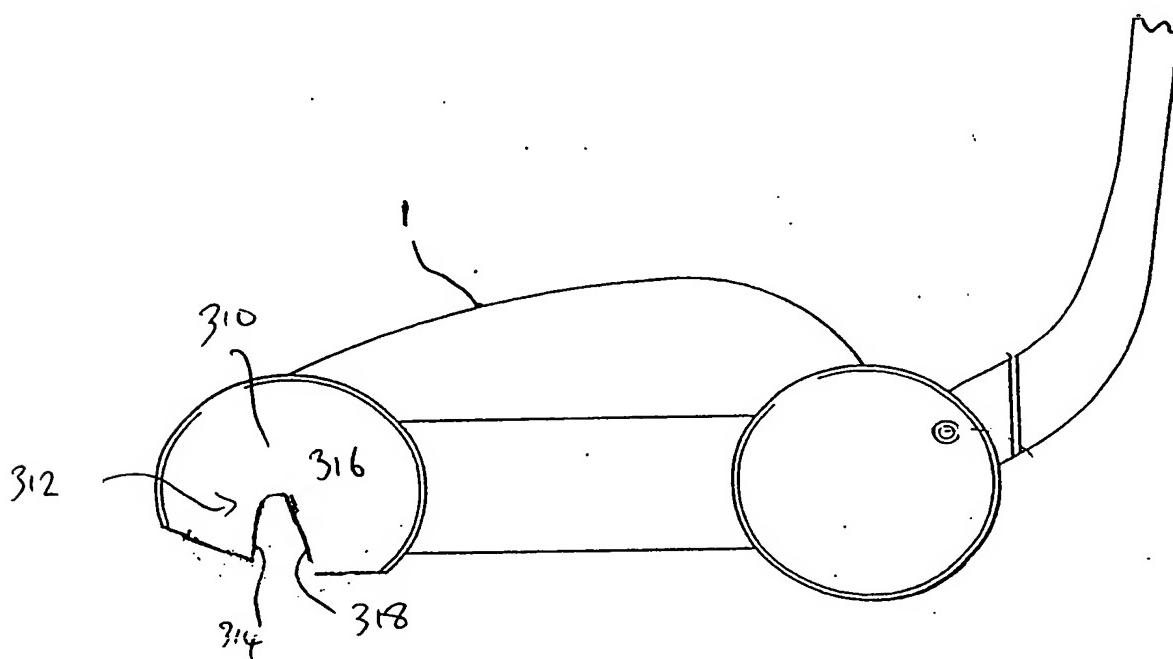


FIG 18



**THIS PAGE BLANK (USPTO)**